PB83-910212

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 16, NUMBER 12
DECEMBER 1983

W83-03851 -- W83-04200
CODEN: SWRABW

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientitsts, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

MERIDIONAL VARIATION OF WATER BALANCE IN RAJASTHAN STATE,
Andhra Univ., Waltai: (India). Dept. of Meteorology and Oceanography.
A. R. Subramaniam, and G. S. L. H. V. Prasada Rao.
Annals of Arid Zone, Vol 19, No 1 and 2, p 51-57, March-June, 1980. 4 Fig, 1 Tab, 2 Ref.

Descriptors: *Hydrologic budget, *Arid lands, *Rainfall distributuion, Droughts, Longitude, Semiarid lands, Climatology, Rajasthan, *India.

The variation of water balance with longitude (70 to 78 degrees E) in the arid to semi-arid state of Rajasthan, India, was evident after an analysis of data from 1901-1977. Potential evaporation is constant in all longitudes for a given year. Precipitation increases from west to east. Water deficiency deceases toward the east. The aridity index decreases gradually from west to east. The west has high aridity and low droughtiness, whereas the east has low aridity and high droughtiness. This is caused by the higher variability of rainfall in the east. Soil moisture storage is zero in the west and increases sharply at 75 degrees E. For the state as a whole, the mean water deficiencies were 986 mm for a normal year, 760 mm for the wettest year (1956) and 1109 mm for the driest year (1966). (Cassar-FRC)
W83-03881

SOME HYDRO-HORTICULTURAL RELATIONS IN A BER ORCHARD (ZIZYPHUS MAURITIANA LAMK.),
Central Arid Zone Research Inst., Jodhpur (India).
R. C. Yadav, K. D. Sharma, H. P. Singh, and O. P. Pareek.
Annals of Arid Zone, Vol 19, No 3, p 297-300, September, 1980. 2 Tab, 4 Ref.

Descriptors: *Orchards, *Runoff, *Slopes, Ber, Rainfall-runoff relationships, *India, Jodhpur.

Rainfall-runoff relationships were studied for 3 years, 1975-77, in a ber (jujube) orchard in India, using 15 combinations of 3 slopes (0.5, 5 and 10%) and 5 lengths of run (5.12 to 14.5 m). Mean seasonal runoff (July to September) from the 3.0 m long natural slope control plot was 9.1 mm per year (3% of rainfall). Mean seasonal runoffs for the sloped plots were: 0.5% plot, 57.7 mm (19.3% of rainfall); 5.0% plot, 120.2 mm (40.1% of rainfall); and 10.0% plot, 99.5 mm (33.2% of rainfall). Runoff, highest in the slopes with 5.12 and 7.0 m lengths, decreased to a minimum in the longest runs. Statistical analysis of the data revealed that 86% of the variation in the runoff was attributable to rainfall. The threshold quantity of rainfall required to produce runoff was 2.5 mm. The average tree height, linear growth, and yield per plot were highly correlated with runoff concentration. (Cassar-FRC)
W83-03882

AN INFILTRATION BASED RUNOFF MODEL FOR A STANDARDIZED 24-HOUR RAINFALL,
Agricultural Research Service, Beltsville, MD.
D. L. Brakensiek, and W. J. Rawls.
Transactions of the ASAE, Vol 25, No 6, p 1607-1611, November/December, 1982. 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall infiltration, *Mathematical models, Rainfall distribution, Runoff volume, Runoff rates, Runoff forecasting, Soil texture, Soil water.

The application of the Green and Ampt infiltration equation to a standardized 24-hour rainfall distribution is described. Procedures for predicting surface runoff amount and duration are developed and illustrated through an example using the Soil Conservation Service (SCS) Type II, 24-hour rainfall distribution. Tabulated values are presented for soil infiltration parameters as a function of soil texture. The example demonstrates the application of the procedure to a given soil texture, antecedent soil water condition, 24-hour rainfall total, and a 24-hour rainfall distribution with the SCS Type II distribution. Other distributions could be used, with the constraint that they are successively monotonic increasing and then decreasing. The predicted runoff amounts and durations could be used to make runoff peak rate estimates. This infiltration approach provides an improved framework for evaluating the effects of land use and practices on runoff amounts and duration. (Carroll-FRC)
W83-03961

PREDICTION OF RAINFALL EXCESS AND SOIL WATER FLUX FROM VARIABLE STORMS ON LAYERED FIELD SOILS,
New South Wales Univ., Kensington (Australia).
A. W. Thomas, R. R. Bruce, and A. A. Curtis.
Transactions of the ASAE, Vol 25, No 6, p 1589-1596, November/December, 1982. 10 Fig, 6 Tab, 15 Ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall infiltration, *Soil water, Mathematical models, Simulation analysis, Storm runoff, Rainfall rate.

A variable rainfall infiltration model derived from soil water flow theory was used to examine the effects of variable rainfall patterns, including non-rain periods, on rainfall excess and soil water fluxes in a layered soil; the effects of different time increments for averaging rainfall input on rainfall excess and soil water fluxes; and the effects of soil profile modification that may conceptually be attributed to water erosion. The effect of antecedent soil water conditions was also studied. The model was applied to a soil profile representing a watershed slope site that had experienced significant erosion and to a profile representing a drainageway where deposition had occurred. The model partitioned rainfall at the soil surface into rainfall excess and infiltrated waters, of which part became stored in profile, with the balance transported to a deeper depth. Regardless of the rainfall pattern, the initial soil water affected the computed rainfall excess significantly, although the effects were more striking for the drainageway profile than for the slope profile. This study showed quantitatively that rainfall excess tended to increase as the centroid of rainfall mass shifted towards the end of the storm, with the trend being much stronger for the drier antecedent soil water condition than for the wetter condition. The effects of time increments for averaging rainfall inputs were much more significant for the drainageway profile than for the slope profile. The storm interruptions increased rainfall capture to a greater degree when the majority of the storm occurred before the interruptions. The soil water flux through a plane in a soil profile was a product of the hydraulic characteristics of all soil layers and the historic and current state of the flow system. (Carroll-FRC)
W83-03962

MODIFICATION OF THE TANGBORN SHORT-TERM HYDROMETEOROLOGICAL MODEL, WITH TRIAL RESULTS FROM THE BAKER RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
M. R. Karlinger, and J. D. Wilson.
Open-File Report 81-694 (WRI), 1981. 63 p, 3 Fig, 1 Tab, 3 Ref, 2 Append.

Descriptors: *Computer models, *River basins, *Snowmelt, *Runoff forecasting, Estimating, Hydrologic data, *Washington, Baker River basin.

A modification of the short-term hydrometeorological model (Tangborn, 1978) for estimating river-basin snowmelt runoff is presented. A multiple-linear regression replaces a nonlinear-regression scheme to correct for temperature effects of snowmelt runoff. Results using Baker River basin, Washington, data indicate that model performance is improved by the modification in a majority of applications and, additionally, use of the model is simplified and computer time is reduced. (USGS)
W83-04009

ASSESSMENT OF HYDROLOGIC CONDITIONS IN POTENTIAL COAL-LEASE TRACTS IN THE WARRIOR COAL FIELD, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
C. Puente, J. G. Newton, and R. H. Bingham.
Open-File Report 81-540, 1982. 43 p, 13 Fig, 5 Tab, 11 Ref.

Descriptors: *Groundwater, *Surface water, *Water quality, *Mine wastes, Coal mining, Mine drainage, Groundwater availability, Streamflow, Flow characteristics, Regression analysis, *Alabama, Warrior Coal Field.

Assessing the hydrology of potential Federal coal-lease tracts, because of their dissemination and limited data, requires some predictive capability. Four tracts assessed were located in the outcrop of three coal groups and of other relatively impermeable rocks in the Pottsville Formation. Physical settings of the tracts and most other areas in the Warrior coal field are similar. This results in similar ground-water and surface-water characteristics, in similar impacts resulting from surface coal mining, and in maximizing the transfer-ability of data. Assessments of the tracts reflected the small storage of water in underlying rocks and corresponding low yields to wells and to the base flow of streams. Ground water and surface water in undisturbed areas are generally of good quality. Some subbasins in the tracts have already been impacted by mining. Estimates of streamflow characteristics and the availability and quality of ground water in the tracts were made using available methodology, or assessments based on local and regional data. Estimates of the degree mineralization of surface-water were made using methodology developed from other coal hydrology work. Climatic, physiographic, hydrologic, and land-use data were analyzed by regressions to derive relations for assessing water quality in streams draining mined and unmined areas. In this approach, an equation was derived to estimate specific conductance. Additional equations, based on relations between specific conductance and other constituents, allow estimates of mine drainage indicators such as hardness, dissolved solids, and sulfate. Hydrologic assessments of the tracts, based on limited verification data, proved to be reasonably accurate. (USGS)
W83-04010

PREDICTING DISCHARGE ON UNGAGED STREAMS FROM RAINFALL MEASUREMENTS IN SOUTHERN ARIZONA,
Arizona Water Resources Research Center, Tucson.
E. S. Simpson, and D. C. Chery.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105352, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, July 1983. 47 p, 25 Fig, 2 Tab, 17 Ref. OWRT A-077-ARIZ(2), 14-34-001-7005/7006.

Descriptors: *Parametric hydrology, *Hydrologic models, Computer models, *Streamflow forecasting, Runoff forecasting, *Arizona, Rainfall intensity, Model studies.

Recent developments in the numerical solution of the governing partial differential equations for overland and channel flow (represented by sets of intersecting planes) should make possible models which predict runoff from ungaged streams. However, these models (physically based models) are complex and require much computer time. Parametric models exist which have the advantage of being relatively simple, and once calibrated may be used efficiently and inexpensively. This study developed a procedure for calibrating a parametric model against physically based model utilizing base areas of one acre and one square mile, with the expectation that base areas can be combined to model real watersheds. Simulation experiments with the physically based model showed that, for the one-acre base area, the dominant parameters relate to the slope and friction of the planes, whereas for the square-mile area, the dominant parameters relate to the channel properties. The simple model-fitting parameters were the cell stor-

age ratio, K, for the one-acre area, and K plus a lag factor, L, for the square-mile area. These parameters decreased more or less exponentially with increasing rainfall intensity and with changes in the physical parameters that produced high peaks and fast runoff.
W83-04137

MODELING AND ANALYSIS OF HYDRAULIC INTERCHANGE OF SURFACE AND GROUNDWATER,
Nevada Univ. System, Reno. Desert Research Inst.
A. B. Cunningham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105436, Price codes: A05 in paper copy, A01 in microfiche. Publication No H-W34, July 1977. 89 p, 31 Fig, 5 Tab, 41 Ref. OWRT B-078-NEV(3), 14-31-0001-5089.

Descriptors: *Hydrologic models, *Groundwater movement, Base flow, Groundwater storage, *Sensitivity analysis, Truckee River, Hydraulic interchange, *Nevada, Model studies, *Surface-groundwater relations.

A technique for modeling the hydraulic interchange between surface and groundwater in an unconfined aquifer-river system has been developed. Modeling procedure consists of simultaneous solution of the Saint Venant equations for one dimensional open channel flow and the Boussinesq equation descriptive of two dimensional transient groundwater flow, coupled by an expression for flow through a channel wetted perimeter. Gelerkin finite element technique was utilized in the numerical solution algorithm. Evaluation of model predictive capability was accomplished in three interrelated phases: 1) parameter sensitivity investigations provided information regarding the accuracy to which individual system parameters must be measured in order to insure successful model operaion; 2) examination of predictive uncertainty indicated generally good overall predictive capability and fair to good prediction of extreme high and low river stage and groundwater table elevations, with predictive reliability decreasing with distance from the river channel; and 3) uniqueness of solution investigation provided insight into the reliability associated with extrapolation of model results beyond the limits of observed field measurements.
W83-04145

USE OF DIGITIZED RADAR AND MICROCOMPUTERS TO FORECAST LOCAL FLOODS AND IRRIGATION NEEDS,
Clemson Univ., SC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W83-04158

CRITICAL DURATION ANALYSIS AND PARAMETER ESTIMATION IN ILLUDAS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
H. R. Lemmer, and A. R. Rao.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105618, Price codes: A11 in paper copy, A01 in microfiche. Technical Report No 153, June 1983. 227 p, 44 Fig, 23 Tab, 30 Ref. 3 Append. OWRT C-00090-U(No 0498)(1).

Descriptors: *Urban hydrology, *Urban runoff, *Rainfall distribution, Rainfall rate, *Parametric hydrology, Rainfall-runoff relationships, Computer models, Storm runoff, Urban watersheds, Kentucky, Ohio, Indiana, Louisville, Cincinnati, West Lafayette.

Storm durations are often arbitrarily selected for designing urban drainage systems. The first objective of this study is to develop guidelines for selecting optimal storm durations. The second objective deals with the parameter estimation in rainfall-runoff models. The urban rainfall-runoff model ILLUDAS was used to obtain the maximum runoff rate for a given set of parameters. The maximum runoff rates are studied to obtain the duration that yields the largest runoff rate which is called the critical duration. The sensitivity of the model parameters on the critical duration was studied. Data from the First Street Watershed, Louisville, KY., Mount Washington Watershed, Cincinnati, OH., and Bar Barry Hieghts, West Lafayette, IN. were used in the analysis. The two-stage parameter estimation procedure based on a maximum likelihood estimator and a Bayesian formulation (developed by Soroosian in 1981) was applied to observed rainfall and runoff data from the Mount Washington watershed. The parameters obtained by this procedure yielded runoff estimates which were closer to the observed values than the parameter estimates and runoff computed from the simple least squares parameter estimation procedure.
W83-04163

2B. Precipitation

AGRICULTURAL METEOROLOGY IN CHINA,
Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
N. J. Rosenberg.
Bulletin of the American Meteorological Society, Vol 63, No 3, p 250-257, March, 1982. 4 Fig, 2 Ref.

Descriptors: *Farming, *Meteorology, Climatology, *China, Scientific personnel, Agriculture, Agricultural engineering, Institutions, Research facilities, Planning.

The facilities, studies and research programs at various institutions in China are described, and the scientific work in the fields of agricultural meteorology and climatology is evaluated. The author visited the following institutions: Beijing University, Beijing Agricultural University, Beijing Academy of Agricultural Sciences, the Institute of Geography, the Chinese Academy of Agricultural Sciences, the Central Meteorological Bureau, the Meteorological Institute in Nanjing, the Institute of Plant Physiology in Shanghai, and the Desert Research Institute in Lanzhou. The work at these institutions ranged from simple and repetitive data organization and summarization to quite advanced analysis of climatic zonation and productivity potentials. Most of the work lies between the two extremes, involving computations of various standard indices of potential evapotranspiration or thermal conditions based on heat units. Some interesting multiple-cropping schemes involving intercropping and relay cropping were noted. While the instruments the Chinese were using in their scientific work were frequently copies of western, Russian or Japanese equipment, many workers were unaware of systematic errors in the measurements they were making. This problem appeared to represent the greatest area where aid in agricultural meteorology was needed. Most of the institutions visited by the author have made arrangements for one or two people to study abroad for advanced studies in agrometeorology. (Baker-FRC)
W83-03851

ON SOME HYDROMETEOROLOGICAL ASPECTS OF HEAVY RAINFALL DISTRIBUTION OVER THE PRINCIPAL ARID ZONE OF RAJASTHAN,
Indian Inst. of Tropical Meteorology, Poona.
P. R. Rakhecha, and O. N. Dhar.
Annals of Arid Zone, Vol 19, No 4, p 413-420, December, 1980. 2 Fig, 5 Tab, 5 Ref.

Descriptors: *Rainfall distribution, *Probable maximum precipitation, *Storms, Hydrometeorology, *India, Arid lands, Rainfall intensity, Rainstorms, Areal Precipiation, Local precipitation, Precipitation, Floods, Design storms, Rajasthan.

Distribution of heavy rainfall ovver western Rajasthan in India was analyzed to provide data for managing water resources. In this arid area single-day rainfalls (heaviest recorded, 51.2 cm at Sanchore on September 16, 1893) often exceed 25 cm and sometimes exceed yearly average precipitation. The largest rainstorms with respect to depth-area-duration are listed. The most severe was August 13-19, 1973, when about 32 billion cu m of water was generated. A table lists rainfall magnitudes for 40 selected stations for a one-day rainfall for return periods of 2 to 100 years. Another table lists the highest one-day rainfalls and their return periods (<1000 years in 2 cases) for 18 heavy-rainfall stations. One-day probable maximum precipitation estimates, varying from 30 to 90 cm, are given on a map. (Cassar-FRC)
W83-03872

CLIMATIC STUDY OF WATER BALANCE, ARIDITY, AND DROUGHTS IN RAJASTHAN STATE,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
A. R. Subramaniam, and G. S. L. H. V. Prasada Rao.
Annals of Arid Zone, Vol 19, No 4, p 371-377, December, 1980. 4 Fig, 4 Tab, 3 Ref.

Descriptors: *Droughts, *Arid lands, *Hydrologic budget, Semiarid lands, Rajasthan, *India, Climatology, Precipitation, Rainfall.

The water balances of three stations of Rajasthan state in India were studied for the years 1969-1976. They represented arid (Bikaner), semi-arid (Jaipur), and dry sub-humid (Jhalawar) climates. The driest year during this period was 1969 in Bikaner and Jaipur and 1974 in Jhalawar. Least dry years were 1975 for Bikaner and Jaipur and 1969 for Jhalawar. Aridity trends showed that Bikaner and Jaipur are decreasing in aridity and Jahalawar is increasing in aridity. Although each station experienced 4 droughts in the study period, those at Bikaner and Jaipur were much more severe than at Jahalawar. (Cassar-FRC)
W83-03884

PRECIPITATION-DURATION-FREQUENCY RELATIONSHIPS FOR A MOUNTAINOUS WATERSHED IN SOUTHWEST IDAHO,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. L. Hanson, and R. P. Morris.
Transactions of the ASAE, Vol 25, No 6, p 1637-1640, November/December, 1982. 4 Fig, 3 Tab, 12 Ref.

Descriptors: *Precipitation, *Watersheds, *Storms, Thunderstorms, Snow, Design storms, Seasonal distribution, Elevation, Comparison studies, *Idaho, Reynolds Creek watershed.

A procedure has been developed that can be used to estimate the maximum precipitation amounts for durations of 15 minutes to 24 hours and return periods of 2 to 50 years that are associated with summer, winter, and annual influences and with elevation changes. The precipitation data were obtained from the precipitation gage network on the Reynolds Creek Experimental Watershed in southwest Idaho. Summer maximum precipitation amounts on the watershed were found to be caused primarily by summer thunderstorms at the lower elevations (1200 meters) for durations of 15 minutes to 2 hours, while both summer and winter storms contributed to the maximum amounts for durations greater than 2 hours. At the higher elevations (2100 meters), the annual amounts for maximum 15- and 30-minute durations were caused by both summer thunderstorms and winter storms. Just over 50% of the maximum values for durations of 1 or 2 hours were caused by winter storms, while winter precipitation accounted for about 90% of the annual maximum values for durations of 6 hours or longer. The 6- and 24-hour duration precipitation amounts interpolated from NOAA ATLAS 2 for return periods of 2, 5, 10, 25, and 50 years were about 13% lower than computed values at the 1200 meter elevation on the experimental watershed. At the 2100 meter elevation, 6-hour duration precipitation amounts interpolated from NOAA ATLAS 2 were about 42% less than measured values for the 24-hour durations, and 50% of the measured values or less. The study results suggests that local climatic information needs to be taken into account when published data are used for engineering design projects. (Carroll-FRC)
W83-03974

VARIATIONS IN MONTHLY PRECIPITATION OVER NORTH CAROLINA,
North Carolina State Univ. at Raleigh.
B. K. Eder, J. M. Davis, and P. J. Robinson.
Water Resources Research Institute Report No 185, January 1983. 46 p, 16 Fig, 1 Tab, 3 Append.

Descriptors: *Precipitation, *Local precipitation, *Precipitation rate, *Precipitation intensity, Atmospheric precipitation, Rain gages, Rainfall, Snow, Probable maximum precipitation, Statistical analysis, Histograms, Computers, Rainfall distribution.

In 1973 the WRRI of the University of North Carolina published a technical report entitled 'Precipitation Variability Over North Carolina' by Saucier, Weber, and Bayne. This revised version of that report is intended to update precipitation maps to reflect the 1951-1980 normal period, and to be in a form useful to the general public and to technicians. The spatial and temporal variability of precipitation over North Caroline is examined through a statistical analysis of monthly normal precipitation data. Tables and maps derived from these data provide monthly precipitation means and standard deviations for 85 locations. The precipitation distribution is partially controlled by the geographic position of the state relative to the global atmospheric circulation system. Superimposed on this system are physiographic controls imposed by the Appalachian Mountains in the western part of the state and the Atlantic ocean to the east. The resulting precipitation patterns are quite complex. The annual precipitation has a summer maximum and a winter minimum. Alternating rainy and fair weather caused by atmospheric circulation causes precipitation that is derived mainly from cyclonic storms, which also create major elements of variability and unpredictability. Spring and autumn minima in rainfall are greatly affected by global atmospheric circulation which shift northward and southward in an annual cycle. Resulting precipitation peaks annually occur in February-March and July-August; minima generally occur in May-June and September-October. (Garrison-Omniplan)
W83-03992

DISCUSSION-SEASONALITY OF FLOODING AND THE ASSESSMENT OF SEASONAL FLOOD RISK,
D. R. Archer.
Proceedings of the Institution of Civil Engineers, Part 2, Research and Theory, Vol 73, No 3, p 683-685, September, 1982. 8 Fig, 7 Ref.

Descriptors: *Floods, *Seasonal variations, *Predicting, Rainfall-runoff relationships, Rainfall, Altitude, Tropical regions, Probability distribution.

In this discussion of a paper by D. R. Archer, published in Proceedings of the Institution of Civil Engineers, Part 2, Vol 71, p 1023-1035, December, 1981, the current author states that while there has been a general tendency to assume a simple relationship of rainfall to altitude, studies at present indicated a much more complex relationship varying with both duration and probability. Monthly median rainfall exhibited the strongest positive correlation of depth with altitude. At the other extreme, maximum daily rainfall approaching the physical upper limit exhibits a negative correlation with altitude. The current author suggests avoiding use of the term 'mean annual flood', for, if it means the average value of annual maximum floods, it is very sensitive because of periodicity, particularly in the case of small samples. (Baker-FRC)
W83-04019

2C. Snow, Ice, and Frost

FLOW CONVEYANCE WITH ICE COVER FOR THE NASHWAAK RIVER, N.B.,
New Brunswick Dept. of the Environment, Fredericton. Water Resources Branch.
For primary bibliographic entry see Field 2E.
W83-03853

GLACIERS AS A WATER RESOURCE,
M. F. Meier, and E. F. Roots.
Nature and Resources, Vol 18, No 3, p 7-14, July/September, 1982. 6 Fig, 1 Tab.

Descriptors: Water resources development, *Glaciers, *Snow, *Ice, Water supply development, Water supply, *Data collections, Water demand, Runoff.

Programs of the International Hydrological Program are explained as they attempt to clarify our understanding of the interrelations between snow and ice, climate and water supply. While it is obvious that only some countries are located in cold regions or near high mountains in which they would have an interest in snow-and-ice water resources, it is hoped that glaciological programs such as these will assist these countries in using information and know-how by which they can move their frozen water reserves. Glaciers act as buffers and regulate the runoff from high mountains. Glaciers may also be sensitive indicators of climate, directly. Glacier ice balances may be measured over large areas of the world from aircraft or satellite. Climated history can be studied by observing the annual sequences in ice cores. Specific programs of the IHP have led to the production of training manuals especially for individuals involved in snow and ice hydrology in developing countries; held training courses on snow-and-ice measurements and on snow-avalanche hazard in Sweden; developed a World Glacier Inventory Program; developed a scientific program of combined heat, ice, and water balance studies at representative glacier basins; established a permanent service on the fluctuations of glaciers; sponsored or co-sponsored symposia on many aspects of snow-and-ice science; developed procedures, bibliographies and a manual for prediction of glacier runoff; developed a major new program on large-scale snow studies; and cooperated in the preparation of the forthcoming Satellite Image Atlas of Glaciers and the Atlas of World Snow and Ice Resources. (Baker-FRC)
W83-04021

2D. Evaporation and Transpiration

AN OBSERVATIONAL-DATA BASED EVAPOTRANSPIRATION FUNCTION FOR GENERAL CIRCULATION MODELS,
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
Y. C. Sud, and M. J. Fennessy.
Atmosphere-Ocean, Vol 20, No 4, p 301-316, 1982. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Evapotranspiration, *Model studies, Circulation, Soil moisture, Moisture availability, Soil water.

Nappo's formulation of the moisture availability function was used to derive the beta function of the form employed in the evapotranspiration calculations of various general circulation models (GCMs). The derivation was based on the simulated evapotranspiration in the last 31 days of a 47-day integration of the GLAS climate model. For each land grid point two temperatures were used, one corresponding to the saturated ground and the other to the naturally dry ground. The beta function, which related actual evapotranspiration to the potential evapotranspiration from saturated ground at the actual temperature of the ground, was then obtained by the best fit. The resulting beta function is small at low soil moisture values. This reduces the excessive evapotranspiration from nearly dry ground in summertime. The smoother asymptotic shape of the beta curve at high soil moisture values mitigates the spurious effect of the stronger diurnal temperature oscillation on actual evapotranspiration. The new values of beta are generally lower than those previously used in the GLAS GCM, thereby reducing evapotranspiration over land. The global evapotranspiration fields obtained with the new beta function are virtually identical to those obtained by using two ground temperatures, which are themselves quite realistic. (Baker-FRC)
W83-04116

2E. Streamflow and Runoff

FLOW CONVEYANCE WITH ICE COVER FOR THE NASHWAAK RIVER, N.B.,
New Brunswick Dept. of the Environment, Fredericton. Water Resources Branch.
B. Burrell, and K. S. Davar.
Canadian Journal of Civil Engineering, Vol 9, No 4, p 674-677, December, 1982. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Ice cover, *Channel flow, *Roughness coefficient, Frazil ice, Flow characteristics, Flow velocity, Open-channel flow, River flow, Nashwaak River, *New Brunswick, Water surface profiles, Cross-sections, Slush, Anchor ice, Closed-conduit flow, Hydraulic properties.

Flow conveyance characteristics were studied in a 460 m stretch of the Nashwaak River, New Brunswick, during ice cover (January-March, 1980) and open water (April-July, 1979). Effective flow section (waterway opening under the ice cover), water surface elevation, and discharge were determined. Average cross-sectional properties in open water months were: discharge, 7-165 cu m per sec; mean velocity, 0.19-1.30 m per sec; area, 37-125 sq m; and hydraulic radius, 0.40-1.28 m. Under ice cover these values were: discharge, 4-24 cu m per sec; mean velocity, 0.14-0.34 m per sec; area, 26-75 sq m; and hydraulic radius, 0.18-0.43 m. Water surface slopes were greater during ice cover conditions than in open water. Manning resistance coefficients are expected to be lower under ice cover, but results of this study were complicated by slush and frazil ice, which produced great variability. (Cassar-FRC)
W83-03853

A CONTINUUM MECHANICS APPROACH TO STREAMFLOW MODELING,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, S. N. Prasad, and L. Ubertini.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265041, Price codes: A04 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute Completion Report, July 1983. 49 p, 6 Fig, 100 Ref. OWRT A-058-LA(2), 14-34-0001-2120.

Descriptors: *Hydrologic modeling, *Streamflow synthesis, Ungaged basins, *Surface flow, *Unsaturated flow, *Saturated flow, Free boundary problems, Dynamic interactions, Ephemeral streams, Infiltration, Soil moisture, Overland flow.

This study surveys modeling of streamflow for a given rainfall event, and develops a framework for an approach based on principles of mathematical physics. This approach treats streamflow as a continuum and takes into account dynamic interactions between three modes of flow: (1) surface flow, (2) unsaturated flow, and (3) saturated flow. In this manner, two independent areas of study blend together: (1) soil water and (2) hydraulics of runoff. Surface flow consists of both overland flow and channel flow. Overland flow interacts strongly with movement of moisture beneath the soil surface. Surface flow is described by a boundary value problem involving partial differential equations of hyperbolic type. This problem gives rise to a free boundary problem as a result of dynamic interactions between surface flow and movement of moisture in the porous medium. The porous medium may be partly unsaturated and partly saturated. The movement of moisture and its distribution may give rise to return flow, interflow and baseflow. The moisture movement is governed by partial differential equations of parabolic type in the unsaturated zone and by partial differential equations of elliptic type in the saturated zone. These two zones have strong dynamic interactions and the boundaries defining their interactions are free boundaries. Interflow and baseflow are described by boundary value problems involving these equations and free boundaries.
W83-03996

TECHNIQUES FOR ESTIMATING THE MAGNITUDE AND FREQUENCY OF FLOODS IN

THE DALLAS-FORT WORTH METROPOLITAN AREA, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
L. F. Land, E. E. Schroeder, and B. B. Hampton.
Water-Resources Investigations 82-18, May 1982. 55 p, 24 Fig, 10 Tab, 15 Ref.

Descriptors: *Flood forecasting, *Flood frequency, *Flood discharge, *Regression analysis, Floods, Hydrologic models, Rainfall-runoff relationships, Flood recurrence interval, Flood peak, Urbanization, Hydrologic data, *Texas, Dallas-Fort Worth metropolitan area.

Equations for predicting the magnitude and frequency of floods in the Dallas-Fort Worth metropolitan area were developed from recorded data from streams with drainage areas ranging in size from 1.25 to 66.4 square miles. The U. S. Geological Survey urban rainfall-runoff model was used to generate long-term flood-discharge record for gaged streams in the area. Simulated and recorded annual-peak data were subjected independently to log Pearson III frequency analyses. The results were weighted to determine appropriate discharges for selected 2-, 5-, 10-, 25-, 50-, and 100-year recurrence intervals. These T-year values were then used as the dependent variables in a multiple regression analysis. The independent variable determined to be statistically significant and retained in the resulting equations were drainage area and an urbanization index that expresses the degree of urban development. Analysis of the results shows that a land-use change from rural to fully urbanized is accompanied by a 180% increase in discharge of a flood with a 5-year recurrence interval and about 100% increase in discharge of a flood with a 100-year recurrence interval. (USGS)
W83-04013

DISCUSSION-SEASONALITY OF FLOODING AND THE ASSESSMENT OF SEASONAL FLOOD RISK,
For primary bibliographic entry see Field 2B.
W83-04019

CHARACTERISTICS OF SEDIMENT AND ORGANIC CARBON EXPORT FROM PRISTINE BOREAL FOREST WATERSHEDS,
Woods Hole Oceanographic Institution, MA.
R. J. Naiman.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 12, p 1699-1718, December, 1982. 14 Fig, 6 Tab, 46 Ref.

Descriptors: *Organic matter, *Forest watersheds, *Sediment transport, Organic carbon, Rivers, Stream order, Particulate matter, Quebec, Suspended load.

Sediment and organic matter were measured in 1979-81 in five pristine Quebec streams: First Choice Creek (1st order), Beaver Creek (2nd order), Muskrat River (5th order), Matamek River (6th order), and Moisie River (9th order). During the 2-month spring freshet 71-92% of the annual sediment load and 59-65% of the annual particulate organic matter (POM) load are exported. Sediment yield varies from 1.5 to 7.6 g per sq m per year; POM export, from 1.0 to 6.7 g ash free dry weight per sq m per year; and dissolved organic carbon export, from 3.1 to 48.4 g C per sq m per year. Apparently carbon is rapidly loaded between first and second order streams, after which biological and physical processing increases. POM export/input ratios were 2.5 in the first order stream, 8.3 in the second order stream, and 0.3-0.6 in the higher order streams. In the largest watershed, Moisie River, the C export was 4.7 g C per sq m per year; coarse particulate organic matter, negligible; and oxidation of suspended load, <0.5% per day. Concentrations of organic matter are relatively unaffected by summer storms, diel variations, and depth of sample in the water column. However, in streams processing and retention devices do exert considerable control over the quantity and nature of suspended organic matter. (Cassar-FRC)
W83-04109

EVALUATION OF PEAK PREDICTION PRACTICES IN RELATION TO FLOODS, FLASH FLOODS, AND DAM SAFETY ACT,
Texas Univ. at El Paso. Dept. of Chemical Engineering.
H. S. Oey, and P. W. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105360. Price codes: A08 in paper copy, A01 in microfiche. Water Resources Institute Completion Report, Texas A and M Univ., College Station, September 1983. 141 p, 4 Fig, 16 Tab, 45 Ref, 4 Append. OWRT B-247-TEX(1), 14-34-0001-1268.

Descriptors: *Prediction, Synthesis, *Flood peaks, Runoff peaks, Drainage, Spillway, *Stochastic methods, *Deterministic methods, River basins, Colorado River, Brazos River, *Texas, Data analysis, Data collections.

The primary goal was to evaluate the applicability of a variety of basic and practical methods for prediction an synthesis of flood peaks within the hydrologic regions of the State of Texas. Historic peak flood data for streams of 26 drainage basins, located in the west, east, gulf coast and central regions of Texas were obtained from reports and computer 'printouts' of the Water Resources Division of the U. S. Geological Survey, Austin, Texas. The primary river basins of the streams were the Colorado and Brazos rivers. Streams at all sites were unregulated, natural and had at least seven years of flow records. Drainage basins are predominately rural in population and small in area, i.e., less than 40 - square miles. Historic flood peak data for all the drainage basins were analyzed in the stochastic methods unit of this study. With the aid of statistical tests, the 'best-fitting' frequency distribution was identified and peak flow estimates associated with recurrence intervals of 2, 5, 10, 25, 50 and 100 years were made for all drainage basins. Flood peak estimates associated with the 5, 10, 25, 50, and 100 year recurrence intervals were made for each deterministic method for all the drainage basins. In order to evaluate the deterministic methods, a correlation, regression analysis of these methods to the results of stochastic analysis (observed data) was made for each drainage basin.
W83-04138

2F. Groundwater

DEVELOPMENT OF GROUNDWATER ON A RETREATING BARRIER BEACH IN RELATION TO OVERWASH AND DUNE FORMATION ON CAPE COD, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Botany.
For primary bibliographic entry see Field 3B.
W83-03907

GROUNDWATER-SURFACE WATER INTERACTION AT TOPAZ LAKE, NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
D. R. Price, S. W. Wheatcraft, R. L. Jacobson, and L. P. Bruce.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256776, Price codes: A07 in paper copy, A01 in microfiche. Publication No. 41085, August 1983. 130 p, 24 Fig, 8 Tab, 42 Ref. 2 Append. OWRT B-111-NEV(1), 14-34-0001-9121.

Descriptors: *Lake stages, Lake shore., *Water level fluctuations, *Bank storage, Water chemistry, Seepage, Groundwater movement, *Surface-groundwater reactions, *Nevada, Topaz Lake, *Aquifer characteristics, Recharge, Groundwater recharge.

A hydrologic study was conducted to investigate groundwater-lakewater interactions around Topaz Lake, Nevada, where an alluvial aquifer is hydraulically connected with the off-stream storage reservoir. Basic objectives of the study were: 1) the estimation of aquifer characteristics; 2) the estimation of recharge to the aquifer from the surrounding mountains; 3) the determination of the flux between the aquifer and the lake; and 4) the potential for contamination of the lake or groundwater from the other. While the lake was increasing in storage, aquifer recharge was determined to be 62% from the mountains and 38% from the reservoir substantiating the potential for impact on the aquifer by the reservoir. Groundwater seepage to the reservoir represented only one percent of its total volume, thus, degradation of the reservoir by groundwater is small.
W83-03920

HYDROGEOLOGICAL AND HYDROGEOCHEMICAL STUDIES OF THE UNSATURATED FLOW IN A GRAVEL AQUIFER. PART I. PLANNING AND CONSTRUCTION OF AN ACCESSIBLE SHAFT ENABLING THE SAMPLING OF PERCOLATION WATER AND GASES (HYDROGEOLOGISCHE UND HYDROGEOCHEMISCHE UNTERSUCHUNGEN IN DER UNGESATTIGTEN ZONE EINES KIESGRUNDWASSERLEITERS. TEIL I),
Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Hydrogeologie and Hydrochemie.
B. Merkel, G. Nemeth, P. Udluft, and W. Grimmeisen.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 4, p 191-195, August, 1982. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Aquifer, *Gravel, *Seepage, *Soil gases, *Groundwater movement, Soil temperature, Percolation, Flow, Conductivity, Unsaturated flow, Data collection, Measuring instruments, Automation, Data processing.

Design and construction of an accessible research shaft are discussed. Construction of the shaft had to minimize disturbance to the aquifer which was being investigated. The shaft itself was fitted with ladders and with ladders and with seven platforms at increasing depths to facilitate measurement and maintenance. With this shaft it is possible to study the unsaturated flow from a 12 meter thick aquifer. The pressure head, soil gas composition, and soil temperature can be determined. Seepage water is sampled with suction devices, and pH and conductivity measurements are recorded continously. Automatic data processing ensures a reliable data bank with high resolution potential over a long period. (Titus-FRC)
W83-03940

HYDROGEOLOGIC AND GEOCHEMICAL STUDIES OF SELECTED NATURAL RADIOISOTOPES AND BARIUM IN GROUNDWATER IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 2K.
W83-03989

ISOTOPE HYDROLOGY OF A BASIN AND RANGE GEOTHERMAL SYSTEM,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2K.
W83-04000

A FIELD STUDY OF SOLUTE DISPERSION IN A SHALLOW, UNCONFINED AQUIFER,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
D. F. Leland, and D. Hillel.
Soil Science Society of America Journal, Vol 46, No 5, p 905-912, September/October, 1982. 10 Fig, 2 Tab, 10 Ref.

Descriptors: *Solute transport, *Unconfined aquifers, Drainage, Groundwater flow, Solutes, Diffusion, Advection, *Dispersion, Massachusetts.

A field experiment was conducted in a very shallow, unconfined aquifer on a hillslope site to determine the characteristics of variation of saturated hydraulic conductivity and longitudinal dispersivity and to examine scale effects on quantification of the longitudinal dispersivity. Chloride tracer was injected into the saturated zone, and its downslope movement was monitored by means of multilevel samplers. The results showed that the mean value of the saturated hydraulic conductivity derived from the tracer test measurements is in very close agreement with mean values of saturat-

ed hydraulic conductivity obtained from two sets of independent measurements, namely, tests on core samples and double-ring infilrometer tests. The experiment showed that tracer tests can be useful tools for studying the transport and dispersion of solutes in the field, though experimental design, including spatial layout and type of instrumentation, injection technique, and sampling frequency, must be carefully considered when developing such a study. (Baker-FRC)
W83-04030

FLOW PROCESSES IN THE FISSURE NETWORK MODEL (STROMUNGSVORGANGE IM VERMASCHTEN KLUFTMODELL),
Bundesanstalt fuer Gewaesserkunde, Coblenz (Germany, F.R.).
F. Schwille, and K. Ubell.
Gas- und Wasserfach: Wasser-Abwasser, Vol 123, No 12, p 585-593, 1982. 14 Fig, 1 Tab, 6 Ref.

Descriptors: *Geologic fractures, *Flow, Groundwater, Computers, Drawdown, Fissure water, Fault springs, Groundwater contamination, Hydraulics, Fluid mechanics.

The influence of fissure distribution and fissure aperture size on the flow processes in rock has been studied assuming an idealized, schematic form of fissure systems and based on the known laws of fissure flow. Forty cases with different fissure geometry have been solved based on the assumed parameters of fissures. The computer program has been developed from an existent program for meshed pipe networks. Using some selected examples, the most essential results are presented as patterns of potential and flow distribution. The comprehensive interpretation of the model results permits conclusions to be drawn for practical application in groundwater hydrology. The results obtained are of importance, for example, in evaluating the effects to be expected as a result of groundwater drawdown in the construction of deep rock excavations or of drawdown due to wells. Conclusions regarding the migration of contaminants and localization of contamiantion sources may also be drawn. (Baker-FRC)
W83-04092

ESTIMATION OF AQUIFER TRANSMISSIVITIES USING NUMERICAL MODELS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105550, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, September 1983. 13 p, 26 Ref. OWRT A-097-ARIZ(2), 14-34-0001-1103.

Descriptors: *Transmissivity, Hydrogeology, Model studies, Theoretical analysis, *Aquifer characteristics, *Arizona, Avra Valley aquifer, Groundwater movement.

Inverse modeling of aquifers usually involves identification of effective transmissivities over a finite number of subregions, or zones. Theoretical restrictions on the maximum size of a zone for which effective transmissivities can be properly defined and the desire to obtain a good resolution of the spatial variability of transmissivity may suggest that the aquifer be divided into numerous small zones. On the other hand, considerations of parameter identifiability may require that the number of unknown transmissivities be limited. An inverse approach has been developed in which the number of zones can be as large as deemed necessary on the basis of hydrogeological considerations. However, instead of trying to estimate a similar number of transmissivities, one estimates a smaller number of surrogate parameters which are linear combinations of the original log transmissivities. The number of surrogate parameters is determined through a singular value decomposition of a matrix arising from the linearization of the inverse problem. This singular value decomposition also yields a 'resolution matrix' and an 'information density matrix.' The resolution matrix is indicative of parameter identifiability and can be used to rezone the study area. The information density matrix shows how well the model can reproduce each measured hydraulic head value and can be used to determine the relative value of each datum point for parameter estimation. The methodology is illustrated on the Avra Valley aquifer of southern Arizona.
W83-04157

PREDICTING DEPTH TO THE WATER TABLE BASED ON SPECIES PRESENCE ON AN OREGON COAST DEFLATION PLAIN,
University of Western Ontario, London. Dept. of Plant Sciences.
K. W. Newman.
Canadian Journal of Botany, Vol 61, No 2, p 482-487, 1983. 6 Tab, 9 Ref.

Descriptors: *Water table, Prediction, Vegetation, *Groundwater level, *Water table profiles, Mathematical studies, Model studies, Groundwater, Areal hydrogeology, *Oregon.

A new method for predicting depth to the water table based on plant species present is described. The study area consisted of three transects at right angles to the shore across a deflation plain between Carter Lake and Tahkenitch Creek along the central Oregon coast. Depth to the water table and the presence or absence of 27 species were recorded for 332 quadrats. Quadrats were classified by age according to aerial photographs of vegetation and weighted according to the inverse of their inclusion probabilities. Prediction of water-table depth was based on the intersection of the ranges or 'percentiles of ranges' of the species in a quadrat. Results showed that for 96% of the quadrats, water-table depth was predicted to within 10 cm and for 73% of the quadrats, to within 5 cm. The present method can also be applied to other studies for predicting the value of environmental variables based on species presence. (Geiger-FRC)
W83-04193

2G. Water In Soils

STUDIES ON SOIL MOISTURE STORAGE UNDER CONTOUR FURROW DURING THE GROWING SEASON OF CENCHRUS CILIARIS,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma, C. M. Verma, and A. K. Kalla.
Annals of Arid Zone, Vol 19 No 1/2, p 37-42, March-June, 1980. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Soil moisture retention, *Furrows, Grasses, Germination, Moisture profiles, Soil-water plant relationships, *India, Jodhpur.

Soil moisture conditions were best for germination and growth of Cenchrus ciliaris, a grass, at the center of the furrow. Soil moisture dynamics were weekly at the center of the furrow, middle of the ridge, top of the mound, and center line of horizontal spacing from June to September, 1977 and 1978,in sandy loams at Jodhpur, India. Plant populations per ha for different seeding treatmens were: top of mound, 14757; middle of ridge, 15798; and broadcast on entire mound, 12837. Dry forage yields followed a similar pattern. Moisture retention at the middle of the ridge was similar to that in the center of the furrow. (Cassar-FRC)
W83-03883

MEASUREMENT OF WATER FLOWS IN UNSATURATED MEDIA,
A. I. Budagovskii, and E. M. Gusev.
Water Resources (English Translation), Vol 9, No 2, p 135-144, March/April, 1982. 3 Fig, 2 Tab, 10 Ref. Translated from Vodnye Resursy, No 2, p 36-45, March/April, 1982.

Descriptors: *Unsaturated flow, *Data acquisition, Water management, Water supply, Mathematical equations, Water transport, Groundwater flow.

Control of soil waters plays a substantial role in the solution of water resource problems. Results of measuring water flows in unsaturated media and parameters are needed for substantiating and constructing semiempirical and empirical relations with respect to particular cases of transport, with their subsequent use as a palliative in more general models of the formation of soil waters. The selection of the method to be used for determining the potential of soil water is related mainly to the range of its variations for which the flows are determined. In the case of high moisture contents, when the absolute value of the potential is less than 0.8 bar, it is best to use tensiometers. For coarse-textured soils it is advisable also to use the method of tall columns. It is stressed that the dependence of the coefficient of hydraulic conductivity on soil moisture is essentially ambiguous. This fact indicates the incorrectness of transient method of determining the coefficient of hydraulic conductivity based on the use of the Buckingham-Darcy equation. However, the experience of using the moisture dependencs of hydraulic conductivity obtained by such methods shows that in certain cases they can be used as relatively effective approximation dependence in mathematical modeling of transport processes. (Baker-FRC)
W83-03948

PREDICTION OF RAINFALL EXCESS AND SOIL WATER FLUX FROM VARIABLE STORMS ON LAYERED FIELD SOILS,
New South Wales Univ., Kensington (Australia).
For primary bibliographic entry see Field 2A.
W83-03962

A PROBABILISTIC MODEL FOR ASSESSMENT OF PLANT WATER AVAILABILITY,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
K. B. Rojiani, B. B. Ross, F. E. Woeste, and V. O. Shanholtz.
Transactions of the ASAE, Vol 25, No 5, p 1576-1580, 1588, November/December, 1982. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Plant water potential, *Soil-water-plant relationships, *Probabilistic process, Mathematical studies, Soil water, Projections, Mathematical models, Agriculture, Irrigation.

A probabilistic model has been developed for assessing available soil water. The model predicts upper and lower bounds on the probability of occurrence of soil moisture deficits over a given period starting at any point during the growing season. Data on the amount of plant available water on each day of the growing season generated from soil moisture balance model for a period of 50 years are used as input for the model. Since plant available water is a function of root development and soil water transmission characteristics, the maximum water holding capacity is used as a parameter for the model. As a result, it is possible to predict the probability of occurrence of soil moisture deficits for a range of soil types and plant types. It is also possible to use the model to determine which input parameters have a significant impact on the computed probabilities so that available resources can best be used to obtain better estimates of those parametes. The correlation between the amount of plant available water on successive days is considered in the formulation. Results indicate that the computed probability bounds are extremely close, usually less than 10%, and can be quite useful in the decision making process. The model provides valuable information for the long-term planning of agricultural activities and for assessing the feasibility of providing water by irrigation. (Carroll-FRC)
W83-03972

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF UNSATURATED SOILS WITH THERMOCOUPLE PSYCHROMETERS,
Texas Univ. at Austin. Geotechnical Engineering Center.
D. E. Daniel.
Soil Science Society of America Journal, Vol 46, No 6, p 1125-1129, November/December, 1982. 6 Fig, 1 Tab, 19 Ref.

Descriptors: *Permeability coefficient, *Measuring instruments, Unsaturated soils, Psychrometers,

Clays, Soil properties, Texas, New Mexico, Mississippi.

A method of measuring the hydraulic conductivity of unsaturated soil using the instantaneous profile method with psychrometric probes to measure water potential is developed and described. Soil is compacted into cylindrical tubes, and the tubes are sealed and instrumented with thermocouple psychrometers. The soil is moistened or dried from one end of the tube. Psychrometers are read periodically. Hydraulic conductivity is computed from the psychrometer readings and the appropriate moisture characteristic curve for the soil and then plotted as a function of water potential, water content or degree of saturation. Hydraulic conductivities of six soils were measured at water potentials as low as -80 bars. The measured hydraulic conductivities and moisture characteristic curves were used along with known boundary flux in a computer program to calculate the final water content profiles. Computer and measured final water content profiles agreed tolerably well. Since psychrometers can be used in the field, this method shows promise for in-situ applications. (Baker-FRC)
W83-04025

WATER INFILTRATION AND REDISTRIBUTING IN A SILT LOAM SUBSOIL WITH VERTICAL WORM CHANNELS,
Stichting voor Bodemkartering, Wageningen (Netherlands).
J. Bouma, C. F. M. Belmans, and L. W. Dekker.
Soil Science Society of America Journal, Vol 46, No 5, p 917-921, September/October, 1982. 5 Fig, 18 Ref.

Descriptors: *Soil water, *Infiltration, Channels, Mathematical equations, Silt, *Loam, Soil types, *Macropores, Vertical worm channels, Soil saturation.

The infiltration of water into soil containing macropores which are temporarily being filled with water was investigated. The macropores were dominantly vertical worm channels. Three different types of steady infiltration rates were measured in individual worm channels. The rates were associated with the following conditions: (1) low steady rates of 20 cu cm/min were measured in channels in which the earthworm was still present within 50 cm below the surface of infiltration; (2) higher rates of 140 cu cm/min were measured in long, more or less vertical channels which extended to a maximum depth of 1.6 m below surface; and (3) high rates of 400 cu cm/min were measured in channels which ended within 50 cm below the surface of infiltration, in highly porous mole burrows. The measured, dominant infiltration rate in a channel was used to calculate ponding time on and the associated water movement in the soil matrix after adding 2 cm of water. The latter was calculated with an existing simulation model for one dimensional infiltration in homogeneous soil. Calculations of the pressure head indicated lack of soil saturation. This agreed only with in-situ measurements when small tensiometer cups were used. Large cups intercepted water-conducting macropores, erroneously suggesting saturation of the entire soil matrix. Addition of a 5 cm thick layer of sand to the surface of infiltration made the macropores discontinuous and induced saturated conditions, as measured and simulated. Measurement of infiltration rates into individual macropores, rather than calculation of those rates, is recommended when macropore morphology is irregular. (Baker-FRC)
W83-04026

INTERNAL ENERGY BALANCE AND THE RICHARDS EQUATION,
G. Sposito, and S. -Y. Chu.
Soil Science Society of America Journal, Vol 46, No 5, p 889-893, September/October, 1982. 23 Ref.

Descriptors: *Soil water, *Flow characteristics, Mathematical equations, *Richards Equation, *Unsaturated flow, Flow, *Energy balance.

The fundamental Richards Equation is deduced as a special case of the differential law of internal energy balance for water in an unsaturated soil. No direct appeal is made to the law of mass balance. Thus it is differential balance law and a linear flux law entirely within the energy concept of soil water. The accepted physical equivalence of the two alternate forms of the Richards Equation thereby has been established in a more precise manner. The equation is shown to comprise both heat flux and chemical work terms, in correspondence with the first law of thermodynamics. For the case of isothermal water flow through a rigid, homogeneous soil, the balance law for internal energy reduces to the Richards Equation, with the soil water matric potential as the dependent variable. The result demonstrates that the energy concept of soil water provides a self-consistent method for obtaining the Richards Equation. Either the energy balance concept or the traditional mass-balance approach can be used to establish the macroscopic physical foundations of the Richards equation. (Baker-FRC)
W83-04027

SEASONAL VARIATION IN NUTRIENTS OF FLOODPLAIN AND UPLAND FOREST SOILS OF CENTRAL ILLINOIS,
Pacific Southwest Forest and Range Experiment Station, Riverside, CA.
D. L. Peterson, and G. L. Rolfe.
Soil Science Society of America Journal, Vol 46, No 6, p 1310-1315, November/December, 1982. 4 Fig, 1 Tab, 32 Ref.

Descriptors: *Nutrients, *Seasonal variations, *Soil types, Calcium, Magnesium, Potassium, Sodium, Phosphorus, Nutrient cycling, Acidity, Soil properties, Spatial distribution, Temporal distribution, *Illinois.

Soil chemical parameters of adjacent floodplain and upland forests in central Illinois were examined by using intensive replication during a two-year period of sampling. Correlation analysis and information from previous studies were used to identify factors related to this variation. Nutrient pools of all elements except sodium were greater in floodplain soils than in upland soils and were in the following order at both study sites: exchangeable calcium > exchangeable potassium > available phosphorus. Seasonal variation in nutrient content of soils was the result of several environmental factors. Available P in floodplain soils was highly dependent on pH, which was in turn influenced by flooding. There was no evidence of seasonal variation in available P for upland soils. Soil pH was positively correlated with the concentration of exchangeable bases in both soils, especially Ca and Mg in upland sites and may have been influenced by leaching and variation in tree root exudation. The seasonal variation in nutrient pools of forest soils in this study has implications for tree growth, site evaluation, and nutrient cycling in forest stands. (Baker-FRC)
W83-04029

ESTIMATING SATURATED HYDRAULIC CCONDUCTIVITY FROM SOIL MORPHOLOGY,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
J. A. McKeague, C. Wang, and G. C. Topp.
Soil Science Society of America Journal, Vol 46, No 6, p 1239-1244, November/December, 1982. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Permeability coefficient, *Soil properties, *Soil morphology, Mathematical/Equations, Soil water, Ontario, Quebec, New York.

Work was undertaken to develop guidelines for estimating the saturated hydraulic conductivity classes from observations of soil morphology. The guidelines presented, though incomplete and subjective to a degree, improved the estimates of saturated hydraulic conductivity in limited testing by pedologists who were not involved in the study. These guidelines show promise for contributing to improved estimates. The results indicate that it is not feasible to assign a unique K(sat) estimate to near-surface horizons of cultivated soils of a particular series. Tillage practices and current land use have a major effect on soil structure, porosity and density, and hence on K(sat). The K(sat) of the surface horizon is important relative to infiltration and runoff; K(sat) of a B horizon may result in a perched water table; K(sat) of horizons at a depth of about 1 m is related to spacing of tile drains. The eight K(sat) classes designated seem to be appropriate in number, but the class limits should be reassessed when more information is available on the variability of K(sat). (Baker-FRC)
W83-04031

DEFICIT, HIGH-FREQUENCY SPRINKLER IRRIGATION OF WHEAT,
Washington State Univ., Pullman. Coll. of Agriculture Research Center.
For primary bibliographic entry see Field 3F.
W83-04032

CHEMICAL AND MORPHOLOGICAL SOIL CHARACTERISTICS IN A NEW ENGLAND DRAINAGE-TOPOSEQUENCE,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
P. L. M. Veneman, and S. M. Bodine.
Soil Science Society of America Journal, Vol 46, No 2, p 359-363, March/April, 1982. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Drainage, *Soil characteristics, Soil properties, Infiltration, Soil water, New England, Chemical properties, Morphological properties, *Massachusetts.

The chemical and physical properties of soils are studied in a representative Massachusetts catena. The occurrence of specific mottling patterns was noted in relation to soil moisture regimes, and the effectiveness of the present soil taxonomic criteria in separating true Spodosols from podzol-like soils was considered. The soils in this Paxton catena strongly reflected the glacial origin of the parent material. Most soils are underlain within 70 cm by a hardpan which is a dense basal till. The presence of the hardpan severely limits vertical drainage of excess soil moisture. During periods of saturation this water is forced to move laterally down slope because of the low permeability of the hardpan. This laterally moving water causes the soils at lower elevations to be wetter, resulting in the formation of significant mottling in the subsoil of profiles about one-third downslope. The mottling patterns in the B horizons of these moderately well drained soils show some ped and channel ferrans and albans, while irregular sesquioxidic nodules with chromas greater than that of the matrix color can be noted in weakly expressed ped interiors. Soil matrix colors in the somewhat poorly and poorly drained profiles were either 2.5Y or 5Y and characteristically had low chromas. Channel neoferrans were abundant in the Ridgebury soil but less plentiful in the Scarboro soils. Imperfect internal drainage of the hardpan throughout the catena was indicated by low chroma ped interiors and high chroma ferrans on ped surfaces. This mottling pattern reflects very wet but yet unsaturated soil conditions for a significant period of the year. (Baker-FRC)
W83-04036

INTERFLOW OF WATER THROUGH A SLOPING SOIL WITH SEEPAGE FACE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja, and J. D. Ross.
Soil Science Society of America Journal, Vol 46, No 2, p 245-250, March/April, 1982. 10 Fig, 16 Ref.

Descriptors: *Soil water, *Infiltration, *Drainage, Subsurface drainage, Flow, Lateral flow, Subsurface flow, Permeability, Water pollution effects, Water pollution sources, Fate of pollutants.

A theoretical analysis of saturated steady interflow in a sloping soil typical of a valley basin has been extended to analysis of sloping soil with seepage face, such as in the case of lateral flow to a ditch or a stream. Particular attention was given to the

interflow pathways, rates and source areas in a sloping soil on a field scale. The method of Gram-Schmidt orthonormalization was adopted. For a homogeneous soil resting on a sloping impermeable base the effects of slope length to soil depth ratio, soil slope, slope of the seepage face with respect to the base, and boundary conditions at the upper end of the slope were examined. Flow patterns were also examined for cases in which the base was somewhat permeable and/or when water standing in the ditch was covering part or all of the seepage face. The findings provide a step towards a better understanding and simplified description of the pathways, rates and contributing source areas of interflow in a sloping soil underlain by a horizon of very low permeability. The results are relevant especially for subsurface flow of soil chemicals to field runoff. They can also be used as guides to devise amelioration measures where a problem exists. (Baker-FRC)
W83-04040

INFILTRATION PREDICTION BASED ON ESTIMATION OF GREEN-AMPT WETTING FRONT PRESSURE HEAD FROM MEASUREMENTS OF SOIL WATER REDISTRIBUTION,
Southern Illinois Univ. at Carbondale. Dept. of Forestry.
S. K. Chong, R. E. Green, and L. R. Ahuja.
Soil Science Society of America Journal, Vol 46, No 2, p 235-239, March/April, 1982. 2 Fig, 2 Tab, 19 Ref.

Descriptors: *Soil moisture, *Infiltration, *Prediction, Mathematical equations, Permeability, Soil types, Green-Ampt equation, Pressure head, Wetting front, *Hawaii, Oahu.

A simple algebraic equation was derived for calculating the matric pressure head at the wetting front based on in situ soil water redistribution measurements. The pressure head, Hf, is given as a function of antecedent water content. The values of Hf thus obtained were used in the Green-Ampt equation to predict infiltration. The prediction error was small for initially dry soil, suggesting that this method has merit for soils with low antecedent water contents. The Green-Ampt equation was tested for topsoils whose depths ranged between 30 to 40 cm. For the dry antecedent conditions, the different soils required between 2 and 13 cm of infiltration water to be satiated to this depth. Thus the topsoils (Ap horizon) would be the controlling horizon for infiltration of rainfall, especially in areas where rainstorms are short and intense. Nevertheless for long-duration rainfall the application of the Green-Ampt equation must be expanded to subsoil B horizons of generally smaller hydraulic conductivity and porosity and a different soil moisture condition. (Baker-FRC)
W83-04041

WETTING MOISTURE CHARACTERISTIC CURVES DERIVED FROM CONSTANT-RATE INFILTRATION INTO THIN SOIL SAMPLES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
K. M. Perroux, P. A. C. Raats, and D. E. Smiles.
Soil Science Society of America Journal, Vol 46, No 2, p 231-234, March-April, 1982. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Soil water, *Soil properties, Measuring instruments, Darcy's Law, Tensiometer, Water transport, Solute transport, Infiltration, Permeability, Loam, Sand, Clay, Pressure head.

A rapid and precise method for obtaining a wetting curve by supplying a small constant flux of water to the top of a thin section of soil fully occupying a cell of known volume and measuring the pressure head at the bottom with a pressure transducer is described. The method depends on the notion that the increase in moisture content of the soil can be inferred from the influx, provided no water is lost from the sample. If the sample is thin and the rate of application of water is low enough the pressure head difference across the sample will tend toward zero. This condition implies that the measured pressure head and a mean water content are applicable to the whole sample. The technique is demonstrated using a fine sand, a loam, and a silty clay loam, and comparison is made with data obtained from other methods. (Baker-FRC)
W83-04042

LONG-TERM EFFECTS OF MANURE ON SOIL NITROGEN, PHOSPHORUS, POTASSIUM, SODIUM, ORGANIC MATTER, AND WATER INFILTRATION RATE,
Agricultural Research Service, Shafter, CA. Cotton Research Station.
B. Meek, L. Graham, and T. Donovan.
Soil Science Society of America Journal, Vol 46, No 5, p 1014-1019, September/October, 1982. 2 Fig, 6 Tab, 14 Ref.

Descriptors: *Water infiltration, *Minerals, *Land disposal, Sewage disposal, Manure, Land application, Nitrogen, Phosphorus, Nutrients, Sodium, Bicarbonates, Denitrification, Soil water, Permeability, Mineralization, *California.

Changes in soil physical and chemical properties were measured during a 9 year period in plots receiving various rates of manure application. High rates of manure were added to field plots of Holtville silty clay soil in an irrigated desert region. Manure applications resulted in large losses of N, increased levels of K, increased P availability, increased water intake rates during the growing season, and an N mineralization rate of about 5% after the first year. At high rates of application only 42% of the N applied could be accounted for. One application of 180 t/ha of manure in 1971 doubled the sodium bicarbonate extractable P levels in the soil in 1979 compared with that of plots that did not receive manure. The application of manure had only a small or no effect on the water intake rate when it was measured between cropping periods on plots that had been recently tilled, but differences were large when water intake rates were measured while the crop was growing. The increased water infiltration rates during the growing season would be important because of increased crop yields in areas affected by salinity. (Baker-FRC)
W83-04043

DETERMINATION OF SORPTIVITY BASED ON IN-SITU SOIL WATER REDISTRIBUTION MEASUREMENTS,
Southern Illinois Univ. at Carbondale. Dept. of Forestry.
S. K. Chong, R. E. Green, and L. R. Ahuja.
Soil Science Society of America Journal, Vol 46, No 2, p 228-230, March/April, 1982. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Soil water, *Sorption, Infiltration, Permeability, *Oxisols, Mathematical equations, Data acquistion, *Hawaii, Oahu.

A simple, physically based algebraic equation is derived for calculating sorptivity as a function of antecedent soil water content. The wetting fron matric pressure head determined from the field profile redistribution data in a previous study is utilizedin an equation which gives sorptivity as a function of fillable porosity, that is, the difference between the satiated and antecedent soil water content, satiated hydraulic conductivity, and wetting fron matric pressure head. The final equation gives sorptivity explicitly as a function of antecedent water content, with the soil water content and satiated hydraulic conductivity being constants for a given soil. The calculated sorptivity is assessed by its use in the Talsma-Parlange infiltration equation and subsequent comparison of predicted and measured infiltration. The method was tested on seven different sites with 14 infiltration measurements on Oxisol soils of Hawaii. The percentage error between predicted and measured cumulative infiltration ranged from 2.1% to 51.9%, with an average error of 21.8% for the 14 comparisons. (Baker-FRC)
W83-04044

SPATIAL VARIABILITY OF SOIL HYDRAULICS AND REMOTELY SENSED SOIL PARAMETERS,
Texas Agricultural Experiment Station, College Station.
R. J. Lascano, and C. H. M. Van Bavel.
Soil Science Society of America Journal, Vol 46, No 2, p 223-228, March/April, 1982. 9 Fig, 18 Ref.

Descriptors: *Remote sensing, *Spatial distribution, *Soil water, Hydraulics, Soil properties, Simulation, Temperature effects, Scaling, Surface temperature, Model studies.

Remote sensing technology using microwave or thermal radiation detection from spacecraft tends to have a resolution of 25 to 2,500 ha, far in excess of the scale of soil variability. In this study such problems are addressed specifically in regard to the effect of soil variability on surface soil water content, water potential, and temperature. This analysis is based on a characterization of spatial variability by the concept of similar media and by the value of a universal scaling parameter that applies to water content-water potential and water content-water conductivity relationships. This scaling concept is then combined with the appropriate distribution function and with a fiaite difference model of the simultaneous flow of water and heat in a soil profile that is bare. Daily losses by evaporation from the 1.5 m uniform profile at the upper boundary and by drainage at the lower boundary are graphed. Only during the precipitous decline of evaporation from a wet to a dry surface can one expect a significant absolute difference corresponding to the spread of the scale factor. Of direct interest to remote sensing applications is the water content in the top 0.20 m of the soil, the latter being the approximate depth of perception by passive microwave detection, depending on the frequency used. During a rainless period the variation of soil properties does not induce a significant variation of the water content in the surface, with 90% of the expected values in a bandwidth of about 1 mm, or 2 to 5% of the total value. Immediately after a 50-mm rainfall, the variability is greater, about 8 mm, or 10 to 15% of the total value. Variability in surface temperature is also important. (Baker-FRC)
W83-04062

FIELD TESTING OF A TWO-DIMENSIONAL SOIL MOISTURE MODEL SIMULATING WATER TABLE FLUCTUATIONS,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
M. J. Fayer, and D. Hillel.
Soil Science Society of America Journal, Vol 46, No 2, p 396-404, March/April, 1982. 16 Fig, 15 Ref.

Descriptors: *Soil moisture availability, *Model studies, *Water table fluctuations, Water level fluctuations, Groundwater movement, Soil water, *Simulation, *Massachusetts.

The validity of a two-dimensional model of soil-water dynamics in a sloping field was tested with respect to groundwater level fluctuations during several infiltration-drainage cycles. The data from rain recorders, runoff plots, water table wells, tensiometers, and an evaporation pan were used to describe the various initial and boundary conditions. Soil hydraulic properties were determined from undisturbed cores and in situ methods. Comparisons of the predicted and measured water table positions were used to judge the model's capabilities. After two 1-wk periods of no rainfall, during which the actual water table fell 11 and 79 cm, the predicted water table levels were within 1.5 and 8 cm, respectively, of the measured levels. Before and immediately after periods of rainfall, the predicted water table levels were usually within 2 cm of the measured levels. As the water table rose in response to the rainstorm, however, the predicted rise was only one-half that measured in the field. Altering the shape of the moisture characteristic programmed in the model nearly doubled the predicted rise. Hence the discrepancy between prediction and observation may be due to insufficient accuracy in determination of the soil moisture characteristic in the very wet range, or to failure to

account for air occlusion or hysteresis. (Baker-FRC)
W83-04063

FLOW OF KAOLINITE AND SEWAGE SUSPENSIONS IN SAND AND SAND-SILT: I. ACCUMULATION OF SUSPENSION PARTICLES,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W83-04068

FLOW OF KAOLINITE AND SEWAGE SUSPENSIONS IN SAND AND SAND-SILT: II. HYDRAULIC CONDUCTIVITY REDUCTION,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W83-04069

HYDRAULIC CONDUCTIVITY OF SOIL AS DETERMINED FROM CUMULATIVE RUNOFF,
North Dakota State Univ., Mandan. Land Reclamation Research Center.
S. A. Schroeder, G. R. Foster, W. C. Moldenhauer, and J. V. Mannering.
Soil Science Society of America Journal, Vol 46, No 6, p 1267-1270, November/December, 1982. 5 Tab, 12 Ref.

Descriptors: *Permeability coefficient, Mathematical equations, *Runoff, Rainfall-runoff relationships, Infiltration, Green-Ampt, Simulation, Model studies, Soil permeability, Soil properties, *Hydraulic conductivity.

Hydraulic conductivity measurements using a Purdue sprinkling infiltrometer were performed on plots with the resultant data of cumulative runoff vs. time analyzed to determine values of hydraulic conductivity through the use of a cumulative runoff equation based on an infiltration equation proposed by Swartzendruber. No large differences were found between the cumulative runoff method, the infiltration equation it is based on, and an equation from Swartzendruber and Youngs that is similar in form to Philip's infiltration equation for estimating K. Estimated K was generally insensitive to the length of record from 30 to 60 min in these studies. Exponent values for infiltration rate equations could not be accurately determined for the particular soils in this study due to the small difference between the application rate and final infiltration rate. Within the range of data points used, values of hydraulic conductivity K were not sensitive to grouping of data points vs. using every data point available. Random error had little effect on K. Thus the procedure as outlined using Swartzendruber's second proposed infiltration equation and the linear equation derived using Sulaiman's methodology was judged to be as reliable in calculating hydraulic conductivity from cumulative runoff vs. time as several infiltration rate equations. This research establishes the procedure which might be used by other researchers to evaluate hydraulic conductivity of soils under a variety of conditions. (Baker-FRC)
W83-04071

2H. Lakes

LONG-TIME EVOLUTION OF AN UNSTABLE WATER-WAVE TRAIN,
Coastal and Marine Engineering Research Inst., Haifa (Israel). Dept. of Civil Engineering.
M. Stiassnie, and U. I. Kroszynski.
Journal of Fluid Mechanics, Vol 116, p 207-225, 1982. 10 Fig, 1 Tab, 16 Ref.

Descriptors: *Wave trains, *Water surface profiles, *Mathematical equations, Water level, Waves, Jacobian functions, Scrodinger equations.

The long-time evolution of an unstable wave train, consisting of a carrier wave and two 'side-band' components, is investigated analytically. Mathematical expressions involving Jacobian elliptic functions for the wave envelope characteristics are derived. The solution yields the dependence of the long-term evolution on the initial disturbance. Of special interest is the simple formula for the modulation-demodulation recurrence period. The latter is shown to yield results in good agreement with those obtained from numerical solutions of the nonlinear Schrodinger equation. While it is suggested that a system allowing for more interacting components must be considered, it is felt that the approximate analytical solution yields a reliable qualitative indication of the general trends and behavior of the recurrence phenomenon, especially during the onset of the process, where little energy has dispersed out of or entered the simplified system. The analytical solution will be helpful in visualizing the evolution of the water surface level in space and time and in deriving the relevant characteristic scales. Also, it leads to approximate expressions for the mean free-surface variation and mean current. (Baker-FRC)
W83-03855

PRODUCTIVITY MEASUREMENT AND THE STORAGE OF OXYGEN IN THE AERENCHYMA OF AQUATIC MACROPHYTES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. G. Kelly, B. Moeslund, and N. Thyssen.
Archiv fur Hydrobiologies, Vol 92, No 1, p 1-10, August, 1981. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Macrophytes, *Aquatic productivity, *Respiration, *Oxygen transfer, Oxygen uptake, Dynamics, Aquatic plants, Plant tissues, Photosynthesis, Oxygen balance, Model studies, Rivers, Vascular tissues.

For the common and typical river species of aquatic macrophytes, it appears that oxygen storage in their aerenchyma tissues does not significantly affect oxygen release to the surrounding water. Storage of oxygen was negligible, so it did not seem to be important for productivity measurements or modeling oxygen dynamics. This suggests that oxygen measurements should prove as reliable for estimating productivity of most vascular macrophytes as they are in calculating the productivity of periphytic algae. Also, when modeling the effects of macrophyte respiration and photosynthesis in rivers, the storage of gases in aerenchyma need not be taken into account. More research is needed to determine the importance of oxygen transport to roots and rhizomes; however, it should be included with other communityrepiration processes when the simple mass balance equation is used for modeling oxygen dynamics or estimating productivity in rivers. (Geiger-FRC)
W83-03890

SEASONAL VARIATION IN THE MACROINVERTEBRATE FAUNA OF BILLABONGS ALONG MAGELA CREEK, NORTHERN TERRITORY,
National Museum of Victoria, Melbourne (Australia).
R. Marchant.
Australian Journal of Marine and Freshwater Research, Vol 33, No 2, p 329-342, 1982. 2 Fig, 2 Tab, 21 Ref.

Descriptors: *Invertebrates, *Seasonal variation, *Species composition, Streams, Billabongs, Magela Creek, *Australia, Macroinvertebrates, Baseline studies, Macrophytes, Aquatic plants, Species diversity, Aquatic animals, Littoral zone.

The littoral zones of 5 permanent billabongs (pools in or near a creek bed) along Magela Creek, Australia, were sampled for invertebrates monthly from March 1979 to March 1980 as part of a baseline study. The creek flowed only during December to April. In the 3 shallow (2-3 m) billabongs the greatest number of taxa (45) and individuals (1000 per min) were caught in the late wet season and early dry season (April-July). The minimum (18 taxa and 200 individuals per min) was reached at the end of the dry season in December. In the deep channel billabongs (7-10 m) fluctuations were not as marked, about 20-40 taxa and 400-850 individuals per min. Mean compsotion of fauna was similar in all billabongs. Oligochaetes and Hydracarina were the most common groups. Tricladida was less abundant. Taxa which occurred sporadically were Porifera, Hydridae, Gordiidae, and Hirudinea. The growth of macrophytes in the wet season is believed responsible for the seasonal variations. (Cassar-FRC)
W83-03891

ON RELATIONSHIPS BETWEEN STOCHASTICAL CHARACTERISTICS OF AN AQUATIC ECOSYSTEM AND ITS ENTROPY PRODUCTION,
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
P. Braun, and A. H. Gnauck.
Acta Hydrochimica et Hydrobiologica, Vol 9, No 2, p 213-217, 1981. 14 Ref.

Descriptors: *Model studies, *Stochastic processes, *Entropy, *Thermodynamics, Aquatic environment, Probabilistic processes, Mathematical studies, Ecosystems, Ecology, *Markov process, Mathematical equations, Lakes.

An attempt is made to calculate the excess entropy production of an aquatic ecosystem using a stochastic model. An equation is derived demonstrating the relationship between probabilistic and thermodynamic quantities which assumes equivalence of the statistical entropy definition by Boltzmann and the information entropy defined by Shannon . Other equations are presented which provide a Markov process and determine the probabilistic properties of the Markov process. It is possible to calculate thermodynamic and information qualities alternatively by checking the probabilistic behavior of a stochastical dynamic system. An extremal principle which permits an assessment of the further evolution of an aquatic system can also be derived. (Small-FRC)
W83-04045

SEASONAL FLUCTUATIONS IN RIVER BACTERIA AS MEASURED BY MULTIVARIATE STATISTICAL ANALYSIS OF CONTINUOUS CULTURES,
Windsor Univ. (Ontario). Environmental Microbiology Research Lab.
C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
Canadian Journal of Microbiology, Vol 28, No 8, p 959-975, August, 1982. 7 Fig, 6 Tab, 48 Ref.

Descriptors: *Bacteria, *Seasonal variation, *Species diversity, Heterotrophic bacteria, Rivers, Meduxnekeag River, Dunbar River, *New Brunswick, Cultures, Nutrients, Nitrogen, Species composition, Temperature effects, Multivariate analysis, Statistical analysis, Organic matter, Dissolved oxygen, Oxygen.

Continuous culture enrichments of bacteria in two rivers, the Meduxnekeag and Dunbar, New Brunswick, were done using summer and winter samples. The river and/or season influenced species composition and diversity, physiological factors, and nutritional versatility. Diversity of Meduxnekeag bacteria, acclimated to organic matter, increased upon incubation. Diversity of bacteria from Dunbar, a river with high dissolved oxygen levels, decreased. Cell output from the cultures was affected by temperature and nitrogen, with nitrogen as the limiting nutrient. Cell output was not influenced by rivers or season. Species diversity was lower at 5C than at 20C. High N concentrations lowered species diversity. Populations in the river and populations incubated in the chemostat were different, although they were the same at the start of incubation. (Cassar-FRC)
W83-04059

ZOOPLANKTON DIVERSITY AND BIOMASS IN RECENTLY ACIDIFIED LAKES,
Ithaca Coll., NY. Dept. of Biology.
J. L. Confer, and T. Kaaret.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 36-42, 1983. 2 Fig, 2 Tab, 24 Ref.

Descriptors: *Acidic water, *Zooplankton, *Population dynamics, Biomass, Lakes, Adirondack

Mountains, White Mountains Mountain Lakes, Cladocera.

A survey was conducted to determine if effects on zooplankton similar to these found in other regions of the world have occurred in acidified lakes in mountainous regions of the northeastern United States. Samples were taken of zooplankton from 10 lakes in both the White Mountains of New Hampshire and the Adirondack Mountains of New York during July and August of 1979. The findings suggest that recent acidification, or some close correlate of acidification has had a strong effect on both zooplankton diversity and zooplankton biomass. The effects were observed to be a continuous function of pH over a wide spectrum of pH values. A loss of 2.4 species of zooplankton and 22.6 mg dry wt/sq m was correlated with each unit decrease in pH. A continuous decrease in diversity and biomass was noted over the entire pH range of 4.5 to 7.2. Cladocera, with the exception of Holopedium, Polyphemus and Epischura lacustris, Mesocyclops edax, and Cyclops scutifr, were abundant at higher pH values but rare or absent at pH values less than 5. Diaptomus minutus was predominant at pH values less than 5. (Baker-FRC)
W83-04103

TOTAL DISSOLVED SOLIDS AS A PREDICTOR OF LAKE BIOMASS AND PRODUCTIVITY,
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W83-04106

EVALUATION OF THE PHOSPHORUS-CHLOROPHYLL RELATIONSHIP FOR LAKES OFF THE PRECAMBRIAN SHIELD IN WESTERN CANADA,
Alberta Univ., Edmonton. Dept. of Zoology.
E. E. Prepas, and D. O. Trew.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 27-35, 1983. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Lakes, *Phosphorus, *Chlorophyll, Saline lakes, Meromictic lakes, Alberta, Canada, Precambrian Shield, Nitrogen, Nutrients, Eutrophication.

Data were collected on summer chlorophyll (ch1), spring and summer total phosphorus (TP), and total nitrogen (TN) for 25 lakes in Alberta to determine the nature of the relationship between TP and/or TN and Ch1 a. The TP-Ch1 relationship established in this study was also compared to that reported in other studies. The TP-Ch1 relationship found in this study was similar to those reported for lakes on the Precambrian Shield. Also the TN:TP ratios were similar. The mean TN:TP ratio in spring was 34, and in the trophogenic zone in summer it was 37. Both the Ch1:TP and the TN:TP ratios were much higher than those reported by others for lakes in the same area or indeed for other studies on the same lakes. It is suggested that some of these differences arose from the use of different analytical methods in the data gathering segment of the studies. The close correlation between levels of TP and Ch1 a and the high TN:TP ratios found in this study suggest that phosphorus is the nutrient controlling the level of phytoplankton productivity in western Canadian lakes. It is also suggested that dividing the lakes into three categories (shallow productive, thermally stratified, and saline) would improve the correlation between spring TP and summer Ch1. However, the seasonal fluctuations of TP in the shallow productive lakes and the drop in TP levels during the summer in the thermally stratified lakes need further study. (Baker-FRC)
W83-04107

LIMNOLOGY OF LAHONTAN RESERVOIR, 1980-1982,
Nevada Univ. System, Reno. Bioresources Center.
For primary bibliographic entry see Field 5B.
W83-04144

2I. Water In Plants

WATER CONSERVATION BY OPTIMAL IRRIGATION SCHEDULING BASED ON CORN DYNAMIC GROWTH MODEL,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 3F.
W83-03917

THE INFLUENCE OF WATER AVAILABILITY ON WINTER WHEAT YIELDS,
Kansas Agricultural Experiment Station, Manhattan. Evapotranspiration Lab.
For primary bibliographic entry see Field 3F.
W83-04102

WATER CONSERVATION WITH URBAN LANDSCAPE PLANTS,
Texas Water Resources Inst., College Station.
For primary bibliographic entry see Field 3D.
W83-04140

DROUGHT HARDENING OF CROP PLANTS,
Minnesota Univ., St. Paul. Dept. of Horticultural Science and Landscape Architecture.
O. Lee-Stadelmann, and E. J. Stadelmann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105485, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Minnesota, St. Paul, August 1983. 19 p, 1 Fig, 3 Tab, 7 Ref. OWRT A-047-MINN(1).

Descriptors: *Osmoregulation, *Drought hardening, *Drought resistance, *Water stress, Crop plant, Water stress, Recovery, Osmotic adjustment, Peas, Beans.

The relation between drought hardiness and osmoregulation in Pisum sativum (pea) was studied by using pressure volume curve technique with the Richter diagram (relative water content vs. inverse leaf water potential). Two additional water relation parameters (bulk elastic modulus of the leaf and structure coefficient) can be derived from this diagram which could not be obtained from the usual pressure volume curves. Turgor pressure at water saturation and the leaf water potential at turgor loss point are obtained by regression analysis for the individual leaves. Their values for control and drought hardened plants are used to detect osmoregulation. Lower osmotic potentials after removal of water stress indicates osmoregulation (osmotic adjustment). Ten days of water stress during early stages of development followed by rewatering during a prolonged period resulted in decreased osmotic potential, that is higher drought resistance. The elasticity of the cell wall seems to be also an important parameter for drought resistance. A formula was derived to express for the first time mathematically the relation between cell wall elasticity and cell turgor pressure. The formula was applied to evaluate cell wall elasticity in bean leaves. Higher cell was elasticity was found in leaves with higher drought resistance, while osmoregulation was absent. In drought hardened pea plants osmoregulation combined with changes in cell wall elasticity seems to be responsible for drought resistance.
W83-04150

2J. Erosion and Sedimentation

SEDIMENTOLOGY OF ERECT VEGETAL FILTERS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 8B.
W83-03865

SOIL EROSION SIMULATION ON SMALL WATERSHEDS: A MODIFIED ANSWERS MODEL,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Parks, J. K. Mitchell, and J. N. Scarborough.
Transactions of the ASAE, Vol 25, No 6, p 1581-1588, November/December, 1982. 7 Fig, 2 Tab, 26 Ref.

Descriptors: *Soil erosion, *Small watersheds, *Simulation analysis, Mathematical studies, Sediment transport, Sedimentation, Agricultural watersheds, Mathematical models, Erosion rates.

A physically-based soil erosion and sediment transport model whose input parameters may be determined from available information has been developed. This single-event, distributed parameter model, which is based on a fundamental erosion concept, considers typical upland erosion and sedimentation processes of splash erosion, flow erosion, sediment transporation, and deposition. Channel erosion is also included. Total erosion rates are assumed to be the sum of the splash and flow erosion or deposition rates. The model was incorporated with the ANSWERS hydrologic model and tested with data from two small agricultural watersheds of less 10 hectares in area. Hydrologic and sediment discharge simulation results from the model were in agreement with observed data. The model was shown to be applicable to an evaluation not only of temporal variations in sediment yield, but also of spatial variations in net soil erosion contributing sediment yield from a watershed. Further reasearch is needed before the model can be applied to ungaged situations. (Carroll-FRC)
W83-03963

RELATIONSHIP OF THE NATURE OF SUSPENDED CLAY MINERALS TO HYDROLOGIC CONDITIONS,
Oregon State Univ., Corvallis. Dept. of Soil Science.
D. Laird, and M. E. Harward.
Journal of Environmental Quality, Vol 11, No 3, p 433-436, 1982. 6 Fig, 13 Ref.

Descriptors: *Suspended sediments, *Sediment transport, *Soil erosion, Mineralogy, Clays, Willamette Valley, *Oregon, Sediment sorting, Erosion, Seasonal variation.

The clay mineralogy of suspended sediments in transport was studied in a small agricultural watershed in the Willamette Valley, Oregon. Although it was expected that the sediment characteristics would change with the progression of the rainfall season as the rill-gully system developed and eroded material from the B horizon, no seasonal trend in the nature of suspended clays was observed. Instead, the character of the clay minerals depended on the nature of the hydrological event. High-sediment-yield storms with fast-rising hydrographs consistently contained clays which were similar to those of the upper horizons of the watershed soils. Preferential clay mineral enrichment was seen during low-sediment-yield events or during low flow conditions following a major event. Sediments transported during the low-energy events were of the type which is more easily dispersed, for example, well-organized kaolinite and smectite. Clays that were depleted in the low-energy events, such as chlorite intergrades, were generally associated with sesquioxide coatings and gels. This selection pheonomenon was attributed to selective dispersion combined with preferential settling of nondispersed materials. (Cassar-FRC)
W83-03966

SIMULATION OF SOIL EROSION FROM WINTER RUNOFF IN THE PALOUSE PRAIRIE,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
K. H. Yoo, and M. Molnau.
Transactions of the ASAE, Vol 25, No 6, p 1628-1636, November/December, 1982. 3 Fig, 6 Tab, 26 Ref.

Descriptors: *Simulation analysis, *Rainfall-runoff relationships, *Soil erosion, Erosion, Agricultural

watersheds, Mathematical studies, Snowmelt, Channel erosion, Small watersheds, Prairies, Rainfall impact, Overland flow, *Pacific Northwest U.S.

A soil erosion model superimposed on a watershed hydrology model was developed and tested to aid the development of a planning framework for both erosion and watershed studies in the Palouse prairie of the Pacific Northwest, where soil loss from agricultural lands is a severe problem. The watershed model used was the USDAHL model, revised to better fit the Palouse conditions through the addition of a snowmelt routine. The main factors used to calculate rill development and sheet erosion on upland areas as well as channel erosion were precipitation, overland flow, streamflow, snowmelt, organic materials (crop residues and mulches), soil properties, and soil moisture. The soil loss from each hydrologic zone is cascaded to a lower area and finally to the channel. Use of the USDAHL cascading system showed the amount and location, in terms of hydrologic zones, where erosion and deposition occur. Application of the simulation model to two test watersheds showed that upland erosion was the dominant source of soil loss for both the large and the small watershed, while channel erosion was a significant source of soil loss for the larger watershed but negligible for the smaller watershed. Annual, monthly, and most daily simulated soil losses were found to be acceptable when compared with observed values, but some daily simulations did not show good correspondence to observed values. Better definition of the simulation components of both the runoff and erosion models will facilitate the use of the erosion model for evaluation or identification of soil erosion problems and for support of other erosion related studies. (Carroll-FRC)
W83-03973

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: II. FLUVIAL SEDIMENTS,
Department of Agriculture, Guelph (Ontario). Inst. of Pedology.
For primary bibliographic entry see Field 5B.
W83-03987

SEDIMENT AND CHANNEL-GEOMETRY INVESTIGATIONS FOR THE KANSAS RIVER BANK-STABILIZATION STUDY, KANSAS, NEBRASKA, AND COLORADO,
Geological Survey, Lawrence, KS. Water Resources Div.
W. R. Osterkamp, R. E. Curtis, Jr., and H. G. Crowther.
Open-File Report 81-128 (WRI), 1982. 72 p, 25 Fig, 5 Tab, 13 Ref.

Descriptors: *Fluvial sediments, *Sediment yield, *Unstable channels, *Regulated flow, Streamflow, Reservoirs, Bank stabilization, Suspended sediment, Particle size, Stage-discharge relations, Degradation, *Kansas River, Kansas, Nebraska, Colorado.

Analysis of hydrologic data from the Kansas River basin suggests that the channels of the lower Solomon, Saline, and Smoky Hill Rivers have narrowed and stabilized as a result of construction of upstream reservoirs. The Kansas River channel, however, remains relatively unstable and locally active. Streamflow regulation and sediment trapping by reservoirs are possible causes of changes occurring at various Kansas River sites. An inferred deficiency of the suspended-sediment load, however, is likely to cause continuing instability. Suspended sediment in the Kansas River apparently is too sparse to form and maintain stable alluvial banks. The deficiency probably results in an increase of bed material movement, general channel widening, and local braiding. Significant channel degradation is lacking at most sites, but may occur in response to long-term (decades-to-centuries) regulation. Recent degradation near Bonner Springs, Kans., may be the result of sand and gravel removal. Any imposed changes that shorten the channel or reduce the suspended-sediment discharge of the Kansas River are expected to cause additional channel instability. (USGS)
W83-04008

THE MECHANISM OF RAINDROP SPLASH ON SOIL SURFACES,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
M. M. Al-Durrah, and J. M. Bradford.
Soil Science Society of America Journal, Vol 46, No 5, p 1086-1090, September/October, 1982. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Rainfall intensity, *Mathematical equations, Soil types, Precipitation intensity, Splash, Silt, Clay, Loam, Erosion, Soil mechanics.

High-speed photography was used to photograph splash from raindrops impacting various soil materials having variable water potential, bulk density, and shear strength values. From the results of high-speed photography and from soil mechanics principles, a mechanism of splash due to raindrops impacting onto saturated soil surfaces is proposed. A unique relationship between splash angle and soil strength as measured by the fall-cone device existed for six midwestern US soils. However, splash weight was not a unique function of splash angle for all soils. The explanation for this phenomenon is that under the impact of a high velocity, single waterdrop soil fails under an undrained condition. The volume of soil in the cavity created by the compression forces (only) of the waterdrop is offset by an equal volume of soil in the bulge developed around the perimeter of the depression. The greater the depth of waterdrop penetration (or compression), the larger the bulge volume. As the bulge volume increases, the splash angle increases. Thus a unique relationship was experimentally found between splash angle and strength. It is assumed that splash angle is a function of depth of raindrop compression and bulge volume, and strength is a function of cone penetration. Splash weight is related not only to the process of soil compression by waterdrop impact but also to the process of detachment due to lateral water flow across the cavity boundary. It is concluded that the total soil shearing resistance estimated by the fall-cone device and the actual resistance of the soil to the jetting water are probably not equal. (Baker-FRC)
W83-04034

QUANTIFICATION OF SOIL LOSS AND SEDIMENT PRODUCED FROM ERODED LAND,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
D. T. Lewis, and M. J. Lepele.
Soil Science Society of America Journal, Vol 46, No 2, p 369-372, March/April, 1982. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Erosion, *Nonpoint pollution sources, Soil loss, Water pollution sources, Sediment transport, Suspended sediment, Wymore series, *Nebraska.

Quantification was made of soil eroded from slopes and sediment added to stream systems as non-point pollution from a small watershed in southeastern Nebraska. The watershed selected for study was within delineation of severely eroded loessial soils. Calculations of soil loss were based on horizonation and clay distribution in eroded pedons as compared to slightly eroded pedons in the same soil series. Thickness and areal extent of soil loss were used to calculate weight and volume of soil moved from the slopes as well as volume and weight of sediment that remained near its source on the landscape. Amount of soil eroded minus that remaining in local storage suggested an amount added from the watershed as non-point sediment pollution in streams. The method described suggests a way in which soil survey mapping units may be characterized in order to quantify the amount of sediment in storage on the landscape and in stream systems due to past erosion of agricultural land. Doing so will expose the extensive erosion of good agricultural lands and the sediment added to the non-point pollution load. (Baker-FRC)
W83-04037

A LABORATORY METHOD FOR PREDICTING THE SIZE DISTRIBUTION OF SEDIMENT ERODED FROM SURFACE SOILS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
F. E. Rhoton, L. D. Meyer, and F. D. Whisler.
Soil Science Society of America Journal, Vol 46, No 6, p 1259-1263, November/December, 1982. 1 Fig, 6 Tab, 10 Ref.

Descriptors: Water management, *Soil properties, Water conservation, Soil conservation, Conservation, Texture, Aggregates, Soil aggregates, Rainfall, Runoff, Sand, *Sediment size, *Soil erosion, Mississippi, Iowa.

A study was undertaken to improve the methodology of the exploratory study and to determine if the laboratory method developed to reproduce size distributions of sediment eroded from field plots during simulated rainstorms could be used to duplicate sediment size distributions during such studies on soils with widely differing inherent characteristics. Using samples of surface soil from the field plots, sediment size data were generated in the laboratory by agitating soil suspensions on an orbital shaker after wetting the sample under tension. Once agitated, the samples were separated into 10 size groups ranging from greater than 1,000 to less than 4 micrometers. Soils high in sand and silt produced laboratory and field curves which were quite similar, but curves from soils high in clay and organic matter were less similar. Results from the 17 soils studied indicate that laboratory generated sediment size data can be used to predict size distributions of sediment eroded by simulated rainfall from interrill areas. (Baker-FRC)
W83-04067

HISTORIC CHANGES IN AN URBAN WATERSHED DETERMINED BY POLLEN AND GEOCHEMICAL ANALYSES OF LAKE SEDIMENT,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W83-04110

APPLICATION OF AERIAL PHOTOGRAPHIC AND COMPUTER ANALYSIS TO THE USLE FOR AREAWIDE EROSION STUDIES,
Texas Christian Univ., Fort Worth. Dept. of Geology.
K. M. Morgan, and R. Nalepa.
Journal of Soil and Water Conservation, Vol 37, No 6, p 347-350, November/December, 1982. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Soil erosion, *Photography, *Land use, Erosion, Remote sensing, Aerial photography, Quil Miller Creek, *Texas, Watersheds, Infrared imagery, Urban watersheds, Maps.

Problem erosion areas were identified in the 65 sq km Quil Miller Creek watershed, near Dallas-Fort Worth, Texas, using photointerpretation of color infrared aerial photographs, the Universal Soil Loss Equation, and a computerized land information system. Average soil loss for the area was 6 metric tons per ha per year, computed by field studies, and 5.6 metric tons per ha per year using photointerpretation techniques. Problem areas, defined as those with soil loss at least twice the acceptable 7-11 metric tons per ha per year for this county, were found in 75 cells, comprising 7% of the watershed (June 1980). Average soil losses in the critical areas were 60 metric tons per ha per year. Most were urban construction sites. Monitoring a year later in June 1981 showed an increase to 94 problem area cells in the rapidly urbanizing watershed. (Cassar-FRC)
W83-04185

2K. Chemical Processes

MOBILITY THROUGH SOILS OF CERTAIN HEAVY METALS IN GEOTHERMAL BRINE WATER,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5B.
W83-03896

ESTIMATING THE POTENTIAL FOR OCHRE CLOGGING BEFORE INSTALLING DRAINS,
Agricultural Research and Education Center, Lake Alfred, FL.
For primary bibliographic entry see Field 4A.
W83-03975

HYDROGEOLOGIC AND GEOCHEMICAL STUDIES OF SELECTED NATURAL RADIOISOTOPES AND BARIUM IN GROUNDWATER IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
R. H. Gilkeson, K. Cartwright, J. B. Cowart, and R. B. Holtzman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-258426, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Center Research Report No 180, Univ. of Illinois, Urbana-Champaign, May 1983. 97 p, 13 Fig, 3 Tab, 60 Ref. OWRT B-108-ILL(1), 14-34-0001-8082.

Descriptors: *Aquifer properties, *Barite, *Barium, *Chemical properties, *Glacial events, *Groundwater, *Radium, *Radon, *Sedimentary rocks, *Sulfate, *Uranium, *Thorium.

Dissolved concentration of the natural radioisotopes super 222Rn, super 226Ra, super 228Ra, super 230Th, super 232Th, super 234U, and super 238U and the element Ba super 2+ were investigated in a study of high concentrations of super 226Ra, super 228Ra, adn Ba super 2+ in groundwater from the Cambrian and Ordivician bedrock of northern Illinois. The high radium and barium concentrations are present in the major aquifers - the sandstone bedrock. Therefore, remedial well construction measures will not lower the concentrations. The combined concentrations of super 226Ra and super 228Ra range from 2.3 to 50.2 pCi/L; the majority of analyses exceed the drinking water regulations of 50.0 pCi/L. The super 226Ra/super 228Ra activity ratio range from 0.2 to 41.0; a super 226Ra analysis has no validity for predicting the super 228Ra concentration. Important controls on dissolved super 226Ra concentrations are secondary U on the sandstone matrix and the ionic strength of groundwater. The distribution of accessory minerals that contain super 232Th is believed to be an important control on dissolved super 228Ra concentrations. Locally the dissolved super 226Ra and super 228Ra concentrations are affected by dissolution-precipitation of secondary barite. Dissolved concentrations of super 222Rn and U are less than proposed drinking water regulations. The extreme enrichment in super 234U that occurs widespread in groundwater from the Cambrian and Ordovician bedrock is unique and problematic. The enrichment may reflect recharge of uranium to the bedrock by glacial processes. Dissolved Ba super 2+ concentrations range from 0.01 to 22.4 mg/L. The high Ba super 2; concentrations occur in groundwater that is depleted in dissolved S0 sub 4 2-by anaerobic microbial reactions. A map presents the distribution of Ba super 2; in groundwater from the Cambrian and Ordovician bedrock in northeaster Illinois.
W83-03989

ISOTOPE HYDROLOGY OF A BASIN AND RANGE GEOTHERMAL SYSTEM,
Nevada Univ. System, Reno. Desert Research Inst.
R. L. Jacobson, N. L. Ingraham, and M. E. Campana.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265074, Price codes: A02 in paper copy, A01 in microfiche. Publication No 41087, August 1983. 18 p, 6 Fig, 3 Tab, 12 Ref. OWRT A-098-NEV(1), 14-34-0001-1130.

Descriptors: Stable isotopes, Springs, *Geothermal resources, *Groundwater recharge, Groundwater movement, *Isotope studies, Chemical properties, *Nevada, Dixie Valley.

Almost 100 stable isotopic samples were collected from rain, snow, streams, wells, and hot and cold springs at the Dixie Valley geothermal system. The mountain stream water has a deuterium composition of about -113 degrees/oo (SMOW) and is probably not a major mechanism for recharging the cool groundwater which has a deuterium composition of about -127 deg/oo or the hot spring water with -130 deg/oo. A local meteoric water line was calculated to be variation of D = 5.8 (variation of super 18 0) -25, and the precipitation samples ranged in variation of D between -50 deg/oo and -150 deg/oo, sufficient to produce the isotopic composition of all of the water in Dixie Valley including the hot springs. The four hot springs are isotopically similar and chemically dissimilar, indicating similar recharge environments but differing flowpaths. No groundwater sample contained measurable tritium (<5TU), and the super 14C results are inconclusive. This is because the variation of super 13C values of both the rock carbon and the soil carbon are unknown in this desert environment. Depending upon the variation of super 13C correction factors used, the super 14C groundwater ages are approximately between 2000 and 10,000 years B.P. This is based on 10 water samples and indicate that at least the younger of these waters may be recharged under present day meteoric conditions. An attempt was made to determine the variation of D variation with elevation. The results were inconclusive due at least in part to the melting of the snowpack during sampling.
W83-04000

CONTINENTAL-SCALE VARIATIONS IN PRECIPITATION CHEMISTRY,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. W. Munger, and S. J. Eisenreich.
Environmental Science and Technology, Vol 17, No 1, p 32A-42A, January, 1983. 8 Fig, 4 Tab, 107 Ref.

Descriptors: *Distribution patterns, *Trace metals, *Chemistry of precipitation, *Isohyets, *Fate of pollutants, *Air pollution, *Precipitation, *Ions, Heavy metals, Trace elements, Chemical precipitation, Water pollution sources, Continental hydrology, Cations, Anions, Nitrogen compounds, Sulfur compounds.

Data on precipitation chemistry in North America have been used to generate isopleth maps of ion levels in precipitation to identify regional patterns of major ions and trace metals. Results showed that precipitation chemistry is dominated by local and regional land use patterns and proximity to antropogenic emissions. Acidity in precipitation is highest where emissions of precursor anthropogenic gases are highest and levels of soil neutralizing components are lowest. The semi-arid plains east of the Rocky Mountains are a major source of calcium, magnesium and potassium cations. Ammonium levels are high over central North America due to agricultural activities. Nitrate and sulfate are high near industrial sections of the Great Lakes and the northeast. Sea salt appears to be the main source of sodium and chlorine ions. Levels of lead, zinc and iron are high in atmospheres of urban-industrial areas. Factors controling the strength of these ions and metals may alter regional precipitation in the future. Changes in levels of alkaline substances would have a secondary effect on precipitation acidity. The north Atlantic coast and lower Great Lakes basin display the highest wet-deposition rates for hydrogen, nitrate and sulfate ions. Because of heavy rainfall, the Pacific Northwest has large precipitation loadings of many elements. Levels of nitrate, sulfate and ammonium ions have increased over the past 25 years. More information is needed on historical trends, the precipitation chemistry of the Gulf Coast, Mississippi delta area and southern Rocky Mountains, and the trace metal content of the precipitation of North America. (Geiger-FRC)
W83-04096

MERCURY SPECIATION IN WATER,
Alberta Environmental Center, Vegreville.
For primary bibliographic entry see Field 5B.
W83-04105

2L. Estuaries

PHYSICAL PROPERTIES OF GREAT BARRIER REEF LAGOON WATERS NEAR TOWNSVILLE. II. SEASONAL VARIATIONS,
Australian Inst. of Marine Sciences, Townsville.
E. Wolanski, M. Jones, and W. T. Williams.
Australian Journal of Marine and Freshwater Research, Vol 32, No 3, p 321-334, 1981. 9 Fig, 14 Ref.

Descriptors: *Lagoons, Water properties, *Sediments, Wind, Salinity, Water temperature, Chlorophyll A, Great Barier Reef, *Australia, Light penetration, Suspended solids, Particualte matter, *Seasonal variation, Swamps, Evaporation, Estuarine environment, Estuaries, Coastal waters, *Physical properties.

The two-dimensional distribution of several parameters was routinely measured at weekly intervals throughout 1979 along a transect between Cape Ferguson and Keeper Reef to monitor gradients of salinity and temperature both across the Great Barrier Reef Lagoon and through the water column. The major part of the research dealt with seasonal fluctuations and interrelations between the measured variables, but evidence was also found relating to the possible occurrence of an inverse estuarine circulation in the lagoon. A shallow summer thermocline was frequently observed in offshore waters in the dry season and in calm weather. As a result of evaporation from the lagoon and adjoining mangrove swamps during the dry season, an inverse estuarine circulation can exist when high salinity, sediment-rich, nearshore waters sink below the less saline offshore waters. Only in nearshore waters were the bottom sediments strongly entrained in the water column during strong winds, principally occurring the winter. (Baker-FRC)
W83-03880

THE USE OF LANDSAT MSS DIGITAL DATA IN WATER QUALITY MAPPING OF THE NEUSE RIVER ESTUARY, N. C.,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 7C.
W83-03918

SEDIMENT FRACTIONATION OF CU, NI, ZN, CR, MN, AND FE IN ONE EXPERIMENTAL AND THREE NATURAL MARSHES,
Nebraska Univ.-Lincoln. Inst. of Agriculture and Natural Resources.
C. W. Lindau, and L. R. Hossner.
Journal of Environmental Quality, Vol 11, No 3, p 540-545, 1982. 1 Fig, 3 Tab, 20 Ref.

Descriptors: *Marshes, *Metals, *Sediments, Tidal marshes, Dredging, *Salt marshes, Galveston, *Texas, Heavy metals, Organic matter, Estuaries, Fate of pollutants.

An experimental intertidal salt marsh, constructed with dredged material from the Gulf Intracoastal Waterway near Galveston, Texas, was compared with three nearby marshes of similar mineralogical composition. Substrate concentrations of the metals (micrograms per g) in the four sites were: Cu, 5.1-13.4; Ni, 2.7-14.1; Zn, 5.6-61.5; Cr, 9.4-40.2; Mn, 30-263; and Fe, 3200-18,700. Generally, the metals levels were highest in the lowest elevations (0.20) sampled. Fractionation studies showed that Cu, Ni, Zn, and Cr were partitioned in a similar way in both natural and experimental marshes. Micronutrients and heavy metal concentrations in the exchangeable and water-soluble fraction were low compared with other fractions. About 30% of the total substrate Cu, Ni, and Zn was associated with the organic matter-sulfide fraction. About 53% of the experimental marsh Mn substrate content was associated with the easily reducible fraction, compared with the natural marsh's 11%. Iron associated with the organic matter-sulfide fraction of the experimental marsh was about 10% lower than the natural marsh samples. About 30% of the experimental marsh Fe was associated with the Fe oxides, compared with an average of 18% for the natural marshes. These differences may be the

result of the differences in age and stage of development of the two types of marshes. (Cassar-FRC)
W83-03968

WATER RESOURCES DEVELOPMENT OF PRAIRIE POTHOLE LAKES IN NORTH DAKOTA: SECONDARY PRODUCTION,
North Dakota State Univ., Fargo. Dept. of Zoology.
J. J. Peterka, and W. D. Wiedenheft.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265124, Price codes: A04 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State University, Fargo, August 1983. 47 p, 9 Fig, 7 Tab, 12 Ref, 1 Append. OWRT A-073-NDAK(1), 14-34-0001-1136.

Descriptors: *Salamanders, Larvae, Biomass, *Secondary productivity, Wetlands, Life history cycles, *North Dakota, *Pothole lakes, Water pollution effects.

The intent of this study was to investigate the secondary production and biology of salamanders (Ambystoma tigrinum) in prairie pothole lakes. The life-forms found were 1) young-of-the-year (larvae from time of hatching to end of the growing season), 2) neotenics (larvae which had over wintered), and 3) adults. In the three lakes studied, maximum production of salamanders (young-of-the-year) ranged from 0.4 to 2.0 kg/ha per day from August to mid-September. Maximum biomas of salamanders was reached in August to mid-September and ranged from 80 to 180 kg/ha. By late September, average weights of young-of-the-year ranged from 60 to 130 g wet weight. Salamander eggs were first observed in early May and hatching occurred by late May. In two of the lakes, only adults were captured in early May; in the third lake both adults and neotenics were captured in early May. Adults and neotenics were not captured after late July. Apparently, only adults reproduced, and their population estimates made in April and early May ranged from fewer than 5 in one lake to about 1000/ha in another. Trends in biomass followed trends in numbers with the lowest biomass occurring in the spring and the peak biomass occurring in late July-mid September and a low biomass by October.
W83-04005

VARIATIONS OF THE FRASER RIVER PLUME AND THEIR RELATIONSHIP TO FORCING BY TIDE, WIND AND DISCHARGE,
British Columbia Univ., Vancouver. Dept. of Oceanography.
L. Royer, and W. J. Emery.
Atmosphere-Ocean, Vol 20, No 4, p 357-372, 1982. 7 Fig, 3 Tab, 9 Ref.

Descriptors: *Plumes, *Spatial distribution, *Temporal distribution, Distribution, Variations, Fraser River, Rivers, Tidal rivers, Tidal hydraulics, Tidal currents, Water currents, Waves, Wind.

Temporal and spatial variations of the Fraser River Plume in the central Strait of Georgia are monitored by continuous salinity sampling of the engine cooling water on two ferry boats. Comparisons between time series of average salinity, maximum salinity gradient and river discharge demonstrate that, for both northern and southern ferry sections, low salinities and high horizontal salinity gradients correspond to peaks in the river discharge. In general the salinity increases along each section towards Vancouver Island. In terms of daily variance the plume appears to progress towards Vancouver Island during the June increase in discharge. No such progression is seen in the southern section. In terms of frequency, possible wind and discharge contributions to plume variability are well separated. Cross-correlations and cross-spectra between the plume characteristics and the along-strait wind are compatible with the along-strait advection of the plume. A positive wind will drive the plume to the northwest, raising the average salinity and lowering the salinity gradient at the southern section. At the same time this advection will sharpen the salinity gradient at the northern section. A linear combination of the effects of wind and discharge was found to substantially improve the correlations between plume characteristics and the driving forces. The harmonic analysis of eight tidal constituents confirmed the combined effects of tidal advection and tidal modulation of the river discharge. During ebb-tide, tidal currents advect the plume towards the southern section, and the slack tide allows maximum river discharge. For a flood-tide the reverse is true, so that while the tidal currents move the plume northward, the tide is gradually restricting the river outflow. For the northern section, the two processes oppose each other, leading to uncertain statistical results. (Baker-FRC)
W83-04117

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

BIPHASE TURBINE FOR REVERSE OSMOSIS DESALINATION,
Transamerica Delaval, Inc., Santa Monica, CA. Biphase Energy Systems.
For primary bibliographic entry see Field 8C.
W83-03910

SOLAR POWERED ELECTRODIALYSIS - PART II,
Ionics, Inc., Watertown, MA.
J. E. Lundstrom, M. M. Socha, and J. D. Lynch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256784, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, April 1983. 107 p, 53 Fig, 17 Tab. OWRT C-90305-D(No 9532)(1), OWRT 14-34-0001-9532.

Descriptors: *Electrodialysis, *Solar power, *Desalination plants, Brackish water, *Design, Water supply, *Cost estimates, Costs, Wells.

The critical components in the design of a solar-powered, electrodialysis (SPED) plant have been evaluated and technology developed to combine ED equipment with a photovoltaic (PV) array. The plant design developed in Part II is simplified from the Part I design in three areas. First, the system uses a flat-panel PV array rather than PV concentrators. Second, the system voltage is maintained at the voltage corresponding to the peak power output of the array which is essentially independent of the level of solar insolation. The third simplification is in the flow diagram for the plant where the number of pumps and variable flow valves has been reduced to two of each. In areas of high solar insolation such as in the southwestern states, a SPED plant can be expected to produce of the order of 190 cubic meters of fresh water from a surface, brackish water source per year per square meter of array. If the source is ground water, some of the power is consumed by the well pump and the production is reduced. In the case studied, the water was raised from a 60 meter well and the production of fresh water was about 25-30% less. Even with a well, however, the water cost can be less than $1.85 per cubic meter of fresh water. The proposed system is expected to provide a reliable supply of fresh water from a brackish water source with minimum maintenance. In certain applications where grid power is unavailable and fuel costs exceed $.40 per liter, the solar-powered plant is expected to provide lower cost water today.
W83-03921

THE EFFECT OF WATER PRETREATMENT CHEMICALS ON THE PERFORMANCE AND DURABILITY OF REVERSE OSMOSIS MEMBRANES,
California Univ., Los Angeles. Dept. of Chemical, Nuclear, and Thermal Engineering.
J. W. McCutchan, J. Glater, S. McCray, M. Zachariah, and K. Nobe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105402, Price codes: A09 in paper copy, A01 in microfiche. Completion Report, April 1983. 185 p, 66 Fig, 11 Tab, 64 Ref, 1 Append. OWRT C-00201-D, (No 0470)(1).

Descriptors: *Reverse osmosis, *Cellulose acetate membranes, *Polyamide membranes, Chemical disinfectants, Chlorine, Bromine, Iodine, Chlorine dioxide, Bromine chloride, Ozone, Hydrolysis, Membrane damage, Water flux, Salt rejection, Acetyl, Pretreatment, *Desalination, Wastewater treatment.

Performances of several commercial reverse osmosis membranes, cellulose acetate, aromatic polyamide and two thin film composite membranes, were examined when exposed to halogen disinfectants and ozone. Polyamide and thin film composite membranes failed when exposed to chlorine, chlorine dioxide, bromine and bromine chlorine. Cellulose acetate membranes of varying acetyl contents were resistant to halogen disinfectants except for some membrane deterioration at low and high pH levels. The latter has been ascribed to membrane hydrolysis rather than halogen attack. All membranes were severely damaged when exposed to ozone, but were resistant to iodine. Cellulose acetate membranes were hydrolyzed at high and low pH levels causing membrane failure. Changes in water and salt fluxes with exposure time at various temperature and pH levels suggest the greater importance of salt-water coupling in salt transport than in water transport. Acetyl content of membranes also affects transport rates.
W83-04143

A STUDY OF ADSORPTION OF COLLOIDS BY POLYMER SURFACES FOR PRETREATMENT OF WATER,
Missouri Univ.-Rolla.
S. Friberg, and H. Yasuda.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105451, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, June 1983. 89 p, 31 Fig, 10 Tab, 102 Ref. OWRT C-80330-S(No 9410)(1).

Descriptors: *Adsorption, Coagulation, *Colloids, Electrochemistry, Filter-media, Films, Polyelectrolytes, Polymers, *Pretreatment of water, Proteins, Silica, Polymer surfaces, Surfactants, *Desalination processes, Wastewater treatment.

The basic principle applied to remove colloids from sea-water to be rendered for membrane desalination processes, such as reverse osmosis and electrodialysis, etc., is the adsorption of colloids which are negatively charged by the positively charged polymer surfaces. A simple model for seawater was used in which silica and iron represented the inorganic colloids, and sodium dodecylsulfate, anionic surfactant, and whey protein the organic colloids. As the adsorbing surfaces, the surfaces of polypropylene films were rendered cationic by 1) hydrophobic implantation of cationic surfactant, and 2) surface grafting of 2-vinyl pyridine via activation of surface by argon plasma treatment. The grafted vinyl pyridine was quartenized in the washing process to form positively charged surface. The grafted polypropylene showed a strong adsorption of the anionic surfactant, and whey protein and their adsorption characteristics were found to be roughly proportional to the surface charge density. Because of adsorption equilibrium, the near complete removal of colloids by the adsorption technique cannot be achieved. The attempt to utilize electrically charged ultrathin layer coated metal surface has lead to discovery of an efficient removal method which utilizes the spot corrosion of aluminum in presence of chloride ion and Galvanic potential. The silica content was reduced from 100 ppm to about 5 ppm. The corresponding reduction of iron concentration was from 2 ppm to 0.05 ppm.
W83-04147

FINAL PRETREATMENT FILTERS FOR REVERSE OSMOSIS DESALINATION,
Rohm and Haas Co., Spring House, PA.
P. G. Cartier, and R. R. Rowe.

Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105600, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, (1983). 92 p, 3 Fig, 19 Tab, 9 Ref, 1 Append. OWRT C-90239-D(No 0417)(1).

Descriptors: *Pretreatment, *Reverse osmosis, *Ion exchange, *Filtration, Water purification, *Desalination, Water treatment, *Ultrafine ion exchange, *Precoat filtration, Floc.

The objective of this research was to demonstrate that filter media containing ultrafine ion exchange resins(UFIER) can reduce the SDI of municipally treated surface water to 3 or less and serve as a final filter to protect RO membranes. The feasibility of using UFIER floc as a 'bound flocculant' was demonstrated on a small commercial precoat filtration system. SDI in the 1-2 range could be maintained for several hours. More typically, SDI of equivalent of 4 could be maintained for equivalent of 20 hours. The later results were obtained at a UFIER consumption of 1-2mg/l of water treated. This dose level is typical of that used for inline coagulation. SDI's in the 1-2 range require a dose ranging from 7-14 mg/l. Therefore, extremely low SDI will likely be costly. If pretreatment to an SDI level of 4 is desired this technique offers an alternative to inline coagulation. Further testing is recommended on two specific precoat compositions (a low SDI/short run and a moderate SDI/long run) to determine if the results on Philadelphia city water are reproducible using other feeds. A supplier of diatomaceous earth precoat filters for pretreating RO feed would be an appropriate choice for this testing.
W83-04162

DESALTING WATER IN FLORIDA,
Florida State Dept. of Environmental Regulation, Tallahassee.
G. M. Dykes.
Journal of the American Water Works Association, Vol 75, No 3, p 104-107, March, 1983. 1 Fig, 1 Tab.

Descriptors: *Brackish water, *Reverse osmosis, *Desalination, Seawater, Groundwater, *Florida, Water treatment, Membrane processes, Saline water, Potable water.

In Florida desalting of brackish groundwater has provided an alternative source of potable water, especially in coastal areas. Most of the 90 plants depend on reverse osmosis. They vary in size from a few thousand gallons per day in small camps and subdivisions to 5 million gallons per day in the cities of Sarasota and Cape Coral. Many operate at 200 psi. In some areas water treated by reverse osmosis is blended with raw water or lime-softened water. Problems of membrane fouling with finely divided limestone and iron particles during well field development and well construction have been solved by using more suitable liners and well casing materials. (Cassar-FRC)
W83-04196

3B. Water Yield Improvement

DEVELOPMENT OF GROUNDWATER ON A RETREATING BARRIER BEACH IN RELATION TO OVERWASH AND DUNE FORMATION ON CAPE COD, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Botany.
P. J. Godfrey, and M. Stroman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255489, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 142, Massachusetts Univ., Amherst, February 1983. 43 p, 17 Fig, 3 Tab, 16 Ref. OWRT A-135-MASS(1), 14-34-0001-9023.

Descriptors: *Groundwater, *Beaches, *Dunes, *Saline water-freshwater interfaces, Wells, Subsurface waters, *Salinity, *Saline water barriers, Beach erosion, Artificial beaches, Intertidal areas, Shores, Salt marshes, Barriers, Sea water intrusion, Aquifers, Chlorophyll, Plant growth, Overland flow, *Massachusetts, Cape Cod, Ammophila.

The groundwater under a barrier beach overwashed by the Great Blizzard of 1978 on Cape Cod was studied during 1980-81. Topographic surveys were made on man-made dunes, small natural dunes, and overwash flats. Thirty-two PVC wells were installed to determine changes in water level and salinity. Soil moisture and salinity were measured at four selected locations. Water potential, leaf resistance, and chlorophyll content of Ammophila breviligulata were also measured. Results showed rapid development of a freshwater zone after dunes were initiated. The water table fluctuated with rainfall. Groundwater under man-made dunes was always fresh, while in overwash flats it varied. Groundwater salinity in the flats declined as summer rainfall increased. Water under dunes was generally less saline than under the flats. Soil salinity was high only where saline groundwater was near the surface. Ammophila was not affected by groundwater; there was no difference between high man-made dunes and low embryonic dunes in water potential of plants. Plants closer to the water table had slightly higher chlorophyll. Ammophila dunes are critical for the development of a freshwater lens under an overwashing barrier beach; the amount of freshwater held increases as the dunes grow, and the lens forms soon after a dune starts.
W83-03907

POTENTIALLY FAVORABLE AREAS FOR LARGE-YIELD WELLS IN THE RED RIVER FORMATION AND MADISON LIMESTONE IN PARTS OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING,
Geological Survey, Lakewood, CO. Water Resources Div.
L. M. MacCary, E. M. Cushing, and D. L. Brown.
Professional Paper 1273-E, 1983. 13 p, 14 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater availability, *Water quality, *Confined aquifers, *Confined-water wells, Well yield, Potentiometric level, Water demand, Porosity, Resistivity, Geohydrology, *Madison Limestone, *Red River Formation, Northern Great Plains.

Extensive development of the coal in the Northern Great Plains will require large volumes of water for on-site power generation, gasification, liquefaction, and slurry-pipeline transport. Ground water from Paleozoic rocks might supply, at least temporarily, a significant part of the required water. Hydrologic and geologic criteria were used to outline potentially favorable areas for large-yield wells (more than 500 gallons per minute). Potentially favorable areas for the Red River Formation, the Madison Limestone, and for the two formations combined are given a qualitative numerical scale. Water quality is the controlling parameter, thus the areas show ground water having greater than 1-ohm-meter resistivity. Depths to the two formations, calcite saturation, water temperature and areas where wells flow are not differentiated on the numerical scale. (USGS)
W83-04011

RESIDUAL-WAX SOIL TREATMENTS FOR WATER HARVESTING,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. H. Fink.
Soil Science Society of America Journal, Vol 46, No 5, p 1077-1080, September/October, 1982. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Water harvesting, *Water repellent soils, Soil types, Soil water, Soil absorption capacity, Runoff, Wax, Paraffin, Watersheds, Water management, *Arizona.

A comparison was made of the weatherability of residual vs. paraffin waxes used as soil treatments for water harvesting. The effectiveness of soil prestabilization and use of antistriping agents for improving the weathering properties of the residual-wax soil treatments was also determined. Ten residual waxes and two paraffin waxes were applied to Tremant soil at three rates. The treated soils were weathered by alternately subjecting them to freeze-thaw cycling, to erosion, and to water repellency testing. The results showed that the less costly residual wax treatments were generally more weather resistant than the paraffin treatments. Generally, the antistripping agent and cellulose xanthate improved weatherability of the waxes tested. With soil prestabilization and the addition of antistripping agents, the wax application rate for most waxes on soils similar to the one tested could be reduced to 0.25 kg/sq m, which is one-fourth to one-eighth the currently recommended rate. (Baker-FRC)
W83-04038

A PROPOSED PHOTOHYDROGEOMORPHIC TECHNIQUE AS AN AID FOR FASTER EXPLORATION OF GROUNDWATER POTENTIAL AREAS IN THE INDIAN ARID ZONE,
Central Arid Zone Research Inst., Jodhpur (India).
P. C. Chatterji, and S. Singh.
Annals of Arid Zone, Vol 19, No 1-2, p 58-64, March-June, 1980. 1 Fig, 3 Ref.

Descriptors: *Groundwater potential, *Geomorphology, *Geohydrology, *Aerial photography, *Arid-zone hydrology, *Hydrologic maps, Groundwater recharge, Groundwater management, Geologic mapping, Deserts, Drainage patterns, Resources development.

Portions of the western Rajasthan desert in India are covered with a blanket of sandy alluvium, making hydrogeological studies difficult. Geophysical studies are often very time consuming and costly. Since systematic hydrogeological investigations have shown than potential aquifers of this area are directly related to geomorphic characteristics, geomorphic studies were carried out using an economical photo-hydrogeomorphic technique. Aerial photographs at three scales were taken to identify gradient, altitude, drainage patterns, nature and thickness of sediments, erosional and depositional features, stable and unstable slopes, rocky strata, and associated joints and fractures. Nine geomorphic units and two water potential zones (the recharge zone and the recharged zone) were identified. In the recharge zone, the surface water potential could be developed to augment the groundwater potential of the adjoining areas, while in the recharged zone, the already exploited groundwater potentials should be rationally utilized to avoid any adverse effects on irrigated lands. (Geiger-FRC)
W83-04121

3C. Use Of Water Of Impaired Quality

IONIC COMPOSITION OF GROUND WATERS IN JIND DISTRICT (HARYANA) AND THEIR SUITABILITY FOR CROP GROWTH,
Central Soil Salinity Research Inst., Karnal (India).
R. C. Sharma.
Annals of Arid Zone, Vol 19, No 1/2, p 43-50, March-June, 1980. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Irrigation water, *Saline water, *Water quality, Haryana, *India, Dissolved solids, Conductivity, Maps, Groundwater, Agriculture, Impaired water use, Anions.

Groundwater samples from the Jind district, Haryana, India, were analyzed to determine their suitability for irrigation. Results are summarized in a map, which shows water quality zones according to electrical conductivity (EC). Most of the district has groundwater of >4000 micromhos per cm, usable only with light textured soils with good drainage and salt tolerant crops. Major anions in the low salinity water were carbonate and bicarbonate. As EC increased, chloride and sulfate became the major anions. Sodium was dominant over the entire range of EC. Mg/Ca ratios varied from 9.5: at EC of 2000 to 2.3:1 at EC of 10,000 micromhos per cm. Average residual sodium carbonate concentrations were highest (2.9 me per liter) in the 1000-20000 micromhos per cm group. Farmers' experience indicated that waters <4000 micromhos per cm were generally considered of good quality for irrigation. (Cassar-FRC)
W83-03866

IMPACT OF SALINE WATER IRRIGATION ON SOME CROPS AND THEIR VARIETIES,
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India). Dept. of Plants and Genetics.
M. Rai.
Annals of Arid Zone, Vol 19, No 3, p 231-237, September, 1980. 6 Fig, 3 Tab, 10 Ref.

Descriptors: *Saline water, *Irrigation water, *Salt toelrance, Water pollution effects, Impaired water use, Wheat, Barley, Sunflower, Safflower, Mustard, Oilseed crops, Grain crops.

Salt tolerance of 13 varieties each of wheat and barley and 10 each of sunflower, safflower, and Indian mustard was studied in 1973-75 in India. Irrigation waters had electrical conductivities (EC) of 0, 4, 6, 8, and 12 mmhos per cm. Germination was affected differently by salinity in each year, some crops being unaffected the first year (wheat, barley, and safflower) and most being affected the second year. Among the oilseed germination of safflower was least affected by salinity, followed by mustard and sunflower. Grain yield of wheat and barley decreased with increasing salinity. Safflower produced 145% better grain yields at 12 mmhos per cm irrigation than the control. Indian mustard produced a maximum yield (137% of control) at 8 mmhos per cum and 110% of control at 12 mmhos per cm. The most salt tolerant varieties were: wheat, HD 15553 in germination and HD2009 in grain yield; barley, Amber; sunflower, EC82362 in grain yield per plant, and EC75272 in grain yield per unit area, and EC97923 in germination; safflower, IC11842 in grain yield and SF5 in germination; and mustard, AppPod-7 in grain yield per plant and T59 in grain yield per unit area and germination. (Cassar-FRC)
W83-03885

A STUDY ON THE EFFECT OF RESIDUAL SODIUM CARBONATE OF IRRIGATION WATER ON THE PROPERTIES OF A LOAMY SAND SOIL AND ON YIELD AND NUTRIENT UPTAKE BY WHEAT AND BARLEY,
S.K.N. Coll. of Agriculture, Jobner (India).
P. Lal, G. C. Mali, and K. S. Singh.
Annals of Arid Zone, Vol 19, No 4, p 395-397, December, 1980. 3 Tab, 5 Ref.

Descriptors: *Sodium carbonate, *Nutrients, *Saline water, Irrigation water, Wheat, Barley, Crop yield, Grain crops, Jobner, *India, Soil properties, Water quality, Water pollution effects, Dissolved solids.

Wheat and barley were grown in pots containing loamy sand soil, irrigated with 5 types of water having the same total concentration (20 meq per liter) but different residual sodium carbonate (RSC) levels (0, 2.5, 5.0, 7.5, and 9.5 meq per liter). Grain yields of both crops decreased with increasing residual sodium carbonate. Grain yield (g per pot) were: wheat, 9.97 at 0 RSC and 7.92 at 9.5 meq per liter RSC; barley, 9.5 at 0 RSC and 8.1 at 9.5 meq per liter RSC. Uptake of phosphorus, potassium, and calcium decreased and uptake of sodium increased with increase in RSC. Electrical conductivity and hydraulic conductivity of the soil tended to decrease with an increase in RSC. (Cassar-FRC)
W83-03888

SALINITY AND TOXICITY OF BRACKISH WATERS OF ARID ZONES OF WESTERN RAJASTHAN,
Defence Lab., Jodhpur (India).
R. Gopal, T. N. Bhargava, O. P. Bhati, T. C. Tak, and P. K. Ghosh.
Annals of Arid Zone, Vol 19, No 3, p 248-250, September, 1980. 2 Tab, 2 Ref.

Descriptors: *Saline water, *Dissolved solids. *Toxocity, *Pollutant identification, Brackish water, Groundwater, Arid lands, Rajasthan, *India, Chlorides, Water analysis.

A total of 1500 groundwater samples from arid zones of western Rajasthan, India, were analyzed. Results showed that 9% of the available water in the region had <500 mg per liter total dissolved solids (TDS) and 49% had less than 2000 mg per liter TDS (considered potable). The TDS ranges (mg per liter) and the percentages of water falling into each class were: <1000, 23%; 1001-5000, 53%; 5001-10000, 19%; and above 10000, 5%. None of the samples were contaminated with As, Ba, Cd, Cr, Pb, Se, Ag, or cyanide. Fluoride concentrations were 0.3-20 mg per liter. Nitrate concentrations were 0.5-100 mg per liter. Half of the samples had F concentrations <2 mg per liter, while only 2% of samples contained nitrate levels above 50 mg per liter. (Cassar-FRC)
W83-03889

EFFECTS ON SOILS AND VEGETATION OF PLANT NUTRIENTS AND HEAVY METALS FROM WASTEWATER-TREATMENT-PLANT SLUDGES DISPOSED ON LAND,
West Virginia Univ., Morgantown. Water Research Inst.
For primary bibliographic entry see Field 5E.
W83-03905

WATER RECYCLING - RESEARCH NEEDS,
Binnie and Partners, London (England).
A. L. Downing, and G. E. Eden.
Water Science and Technology, Vol 14, No 9-11, p 1475-1480, 1982.

Descriptors: *Water reuse, *Research priorities, *Reviews, Monitoring, Quality control, Toxicity, Bacteria, Public health.

Research is needed in many diverse areas concerning the reuse of water. These many different areas are reflections of the many different potential applications of recycled water. A major objective of research is to reassure the public and those bodies of official and unofficial persons who watch over their welfare of the safety of the public water supply, no matter what the source. Research must also be aimed toward enabling the water supplier to carry out his function economically and reliably. Areas of study include epidemiological studies, animal studies, studies with bacteria or cell cultures, biodegradability tests, chemical analysis, microbiological monitoring, standards, treatment processes, industrial effluents, and administrative control. Wastewater purification to potable standard may be too costly and unnecessary for some applications of re-used water which have been proposed, including irrigation, water sports, and many industrial uses. Other general research needs include establishment of pricing policies and incentives, energy production, development of continuous monitoring systems, and alternatives to the water-carriage system for disposal of wastes. (Baker-FRC)
W83-03965

WATER RECYCLING FOR DOMESTIC AND AGRICULTURAL APPLICATIONS: STATE OF THE ART,
Water Research Commission, Pretoria (South Africa).
C. F. Schutte.
Water Science and Technology, Vol 14, No 9-11, p 1447-1463, 1982. 17 Ref.

Descriptors: *Water reuse, *Reviews, Water supply, Water supply development, Irrigation, Drinking water, Public health, Public opinion, Planning, Design criteria, Water quality, Quality control, *South Africa.

This review concentrates on the state of the art of water recycling for domestic use, including agricultural applications. The engineering, public health and quality aspects of indirect reuse, indirect recycling and direct recycling of water in domestic supplies are discussed. There appears to be very little distinction between indirect reuse of water containing effluents and recycling of reclaimed water for domestic applications. These systems must all be regarded as producing water from polluted sources. High priority should thus be given to the development of a set of quality standards for drinking water derived from these sources. The EPA has initiated the process in the United States by organization of the Airlie workshop on protocol development, while the South African Department of Health, Welfare and Pensions has published proposed directives for the recycling of water for domestic applications. Treatment technology does not seem to represent a limiting factor in the implementation of water recycling. Public support for any recycle project is of vital importance. Current recycling projects comprising advanced reclamation technology are performing exceptionally well if judged by the quality of water that is being produced. Recycling of reclaimed water for irrigation of crops and green land areas is a very successful way of using existing water supplies to the maximum or replacing freshwater supplies which could be better used for domestic and industrial applications. (Baker-FRC)
W83-03969

HEALTH RISKS ASSOCIATED WITH WATER RECYCLING,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
H. I. Shuval.
Water Science and Technology, Vol 14, No 9-11, p 1465-1474, 1982. 1 Tab, 5 Ref.

Descriptors: *Water reuse, *Public health, *Health risks, Water quality, Bacteria, Viruses, Salmonella, Sprinkler irrigation, Irrigation, Water supply development, Water supply, Water quality control.

Water recycling is one of the most promising modes of increasing water resources. The most common form of water recycling is what is often called indirect, unplanned, or covert water recycling. This form is practiced wherever surface water is extracted from rivers or lakes into which urban and industrial waste is discharged. Indirect or unplanned water recycling for agricultural purposes is very widely practiced throughout the world. In direct, planned, reuse of water there are a number of legal and moral issues involved which urge that stricter standards be met than in the cases of indirect or unplanned reuse. The earliest form of wastewater reuse was for agricultural irrigation. Municipal wastewater carries with it the full spectrum of pathogenic bacteria, viruses and parasites excreted by the population in the urban community. Direct application of partially treated municipal wastewater or sludges for salad crops or other fruits and vegetables that are eaten raw can lead to the transmission of communicable diseases to the population exposed. A number of countries have established standards regulating the use of wastewater effluent for those crops which are eaten raw and present a high degree of health risk. In many areas of the world, sprinkler irrigation is practiced for agricultural purposes. In some studies aerosolized enteric bacteria have been detected as far as 750 meters downwind from such spray irrigation plots. Enteric viruses and salmonella bacteria have been detected as far as 100 meters downwind from the fields. In industrialized areas the reuse of municipal effluents for cooling water or other purposes in industry is an attractive form of wastewater reuse. (Baker-FRC)
W83-03971

IRRIGATION WITH SIMULATED SECONDARY WASTE WATER ON TILED SOIL CROPPED TO BROMEGRASS AND CORN,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
S. A. Grant, R. J. Kunze, and G. Asrar.
Journal of Environmental Quality, Vol 11, No 3, p 442-446, 1982. 2 Fig, 9 Tab, 28 Ref.

Descriptors: *Wastewater irrigation, *Nutrients, *Tile drainage, Fate of pollutants, Irrigation, Nitrates, Phosphates, *Corn, Bromegrass, Pastures, Fertilizers, Drainage systems, Wastewater disposal, *Sprinkler irrigation, Grasses.

A synthetic secondary wastewater was applied by sprinkler irrigation to a tiled soil cropped to bromegrass and corn over a 6-year period. Application rates were 100 or 200 cm per season. Tile drainage water in the last year of the study, 1978, contained 3.3-8.5 mg per liter nitrate and 0.1-0.4 mg per liter phosphate, with the lower concentra-

tions in the grass plots. Concentrations of nitrate in various soil layers over the 270 cm soil profile were 7.8-25.8 mg per liter in grass plots and 11.4-37.5 mg per liter in corn plots. However, corn removed more nutrients than grass. Adding N fertilizer to corn significantly increased nutrient removal, but adding K fertilizer did not. Peak P and K concentrations preceded the peak tile water flow by about a half hour. (Cassar-FRC)
W83-03985

UTILIZATION OF WATER FROM THE OPEN-CAST MINES SITUATED NORTH OF LEIPZIG (DIE NUTZUNG DES WASSERS AUS DEN TAGEBAUEN NORDLICH LEIPZIGS),
Dresden Forschungszentrum Wassertechnik (German D.R.).
K. -H. Arnold.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 429-433, May, 1980. 1 Tab, 6 Ref. (No English Summary).

Descriptors: *Impaired water use, *Drinking water, *Coal mining, *Groundwater potential, Water resources development, *Water use efficiency, Mining engineering, Water quality, Iron, Chloride, *German Democratic Republic, Leipzig, Delitzsch, Open-cast mining, Geology, Economic aspects, Water pollution, Agriculture, Water treatment facilities, Construction.

At present in the German Democratic Republic, more water is removed in the course of open cast mining than is utilized by all drinking water treatment plants combined, while very little of the mining water is used for drinking. Water removed from the Delitzsch open-cast mine near Leipzig was investigated as to its possible use for drinking. Geological conditions are favorable in this area, where eocene brown coal is mined. There is no danger of high chloride levels, but a danger of agricultural pollution of the groundwater through fertilization and wastewater application does exist. Secondary pollution of surface waters that converge in the mine when it rains is also possible, and this water should be removed. Water treatment facilities must be constructed, taking into account the possibility that groundwater quality may be impaired as its level sinks. In this case, one-stage iron removal should be practiced during the first few years, followed by two-stage removal using the same facilities when iron content increases and water volume decreases. The time period during which mining water is available must also be considered when evaluating the possibility of its use for drinking. For the Leipzig/Delitzsch area, this period is at least 30-50 yr, making drinking water production economical. Analysis of raw water quality in the ring main of the Delitzsch mine revealed that the pH value was 7.4, total iron concentration was 1.3-1.4 mg/l, total manganese concentration was 0.2-0.3 mg/l, and sulfate, chloride, and nitrate levels were 181-203, 72-85, and 0.7-0.8 mg/l, respectively. The water quality prognosis for other mines in the area agreed with these results. (Gish-FRC)
W83-04061

SOME ASPECTS OF THE PRESENT STATUS OF ALGAE CULTIVATION AND THEIR APPLICATION (NEKOTORYE ASPEKTY SOVREMENNOGO SOSTOYANIYA KUL'TIVIROVANIYA VODOROSLEI I IKH PRIMENENIE),
For primary bibliographic entry see Field 5D.
W83-04073

PURIFICATION OF FAECAL WATERS COMBINED WITH ALGAL PROTEIN PRODUCTION (OCHISTVANE NA VODI S FEKALEN KHARAKTER, SUCHETANO S POLUCHAVANE NA VODORASLOV PROTEIN),
For primary bibliographic entry see Field 5D.
W83-04074

USING 'BLOWDOWN' WATER TO IRRIGATE CROPS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, L. H. Stolzy, C. A. Fox, H. J. Vaux, Jr., and I. R. Straughan.
California Agriculture, Vol 37, No 3/4, p 4-5, March/April, 1983. 4 Tab.

Descriptors: *Cooling water, *Irrigation water, *Wastewater disposal, Powerplants, Saline water, Evaporation, Ponds, Fate of pollutants, Impaired water use, Water pollution effects, Seepage, Crop yield.

Irrigating crops with blowdown from powerplant cooling systems was less expensive and resulted in less groundwater pollution than disposing of the blowdown in evaporation ponds. Crops were grown in the arid section of California under leaching conditions designed to produce the maximum adverse impact of saline water on the crops and the minimum pollution of drainage water. The concentration of total dissolved salts in irrigation water was 3000 ppm. Estimated salt emissions below a clay-lined evaporation pond (leaching fraction, 0.4) and two irrigated fields (leaching fractions, 0.2 and 0.1) were 30,000, 28,000, and 27,000 tons per year, respectively. Drainage concentrations (ppm) for the 3 treatments were 14,000, 25,000, and 48,000, respectively. Although the value of the wheat or sorghum crop would not be sufficient for a profitable farming operation, it provides an economic alternative to building evaporation ponds, which have annual costs of $24,000 to $2.5 million, depending on materials of construction. (Cassar-FRC)
W83-04112

ROLE OF MYCORRHIZAE IN LAND APPLICATION OF MUNICIPAL WASTEWATERS,
Louisiana Tech Univ., Ruston. Dept. of Agricultural Engineering.
J. W. D. Robbins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105527, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Louisiana State Univ., Baton Rouge, August 1983. 12 p, 5 Tab, 10 Ref. OWRT B-009-LA(1), 14-34-0001-6083.

Descriptors: *Municipal, *Wastewater, *Land application, Lagoon effluents, *Mycorrhizae development, Soil-water-plant relationships.

Results are presented of a field plot study aimed at developing criteria for applying municipal wastewaters (lagoon effluents) to land. Wastewater management techniques that affect the response of mycorrhizae in trees were tested. Water application rates and frequencies were varied. In all, 97 plots each initially containing 25 loblolly pine and 25 white oak tree seedlings, were studied. Tree roots were sampled and analyzed for mycorrhizal development at 7 and 16 months following initiation of plot treatments. Tree growth parameters were also made. Statistical analyses of the results failed to demonstrate significant differences among the various plot treatments for the parameters measured.
W83-04154

3D. Conservation In Domestic and Municipal Use

DROUGHT MANAGEMENT CONCEPTS: LESSONS OF THE 1976-77 U. S. DROUGHT,
For primary bibliographic entry see Field 6D.
W83-03922

WATER CONSERVATION WITH URBAN LANDSCAPE PLANTS,
Texas Water Resources Inst., College Station.
B. W. Hipp, C. Giordano, and B. Simpson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105386, Price codes: A05 in paper copy, A01 in microfiche. Completion Report No 126, August 1983. 74 p, 16 Fig, 26 Tab, 24 Ref, 1 Append. OWRT A-050-TEX(1), 14-34-0001-1146,2146

Descriptors: *Evapotranspiration, *Water use, Native plants, Consumptive water use, Irrigation, *Urban landscapes, *Texas, Lysimeters, *Water conservation.

Water shortages are a common problem in much of the southwest. Increasing urbanization and increasing population places greater demands on dwindling water supplies. Over half of the water used in urban areas of the southwest is used in the irrigation of landscapes. To help cope with increased urban water demands and low water supplies, research was conducted to gain information relative to consumptive water use by native and non-native landscape plants. Twenty weighing lysimeters were constructed and installed and plants established in the lysimeters and adjacent areas. Plants used in the study were buffalo-grass, St. Augustinegrass, cenizo, boxwood and Texas barberry. All plants are native to Texas except boxwood and St. Augustinegrass. Water use by shrubs in lysimeters was variable and not influenced by plant type during the period of establishment. (Fall 1981). During 1982, water use was influenced more by plant size than by specie or water level. Cenizo had much faster growth rate than the other shrubs in the study. Water use by container grown plants indicated that cenizo had higher water use efficiency than boxwood or Indian Hawthorn. Water use was determined for several native shrubs and of the ones compared, Texas barberry appeared to have the most promise for use in water conserving landscapes.
W83-04140

3E. Conservation In Industry

ASSESSMENT OF WATER RECYCLE AND REUSE POTENTIAL IN THE INORGANIC CHEMICALS INDUSTRY,
Versar, Inc., Springfield, VA.
A. M. Twedell, E. F. Rissmann, J. P. LeBoff, G. A. Riley, and P. A. Hillis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105626 Price codes: A10 in paper copy, A01 in microfiche. Completion Report OWRT/RU-82/17, September 1982. 207 p, 52 Fig, 28 Tab, 49 Ref. OWRT C-90146-R(No 0457)(1).

Descriptors: *Water reuse, *Recycling, *Inorganic chemicals industry, Water quality, Water use efficiency, Water costs, Industrial wastes.

An assessment is presented for the current status of wastewater reuse and recycle in the inorganic chemicals industry and for recycle in future years. The emphasis of the study is directed at the major water-using segments of the industry, which account for over 88% of the industry's gross water use. Each of these segments is characterized by defining their production processes, plant locations, water quantity and quality requirements, and projected growth. The following water use components are estimated for each of the major water-using segments on a national and regional basis for the years 1980, 1985, and 2000: gross water use, recycle, consumption, withdrawal, and process discharge. Recycle estimates are based on an examination of current industry practices, water quality requirements, environmental regulations, water requirements relative to regional water supplies, economic incentives, and new and existing technologies. Water recycle in this industry was found to be limited by process specific constraints and economic feasibility considerations. Significant increases in percent recycle were projected for only three industry segments. The number of cases of water reuse was found to be small, and limited largely by plant location considerations.
W83-04164

3F. Conservation In Agriculture

FEDERAL TAX LAWS AND SOIL AND WATER CONSERVATION,
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6E.
W83-03857

SUPPLEMENTAL IRRIGATION TO WHEAT FROM RUNOFF HARVESTED WATER UNDER DRY FARMING CONDITIONS,
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
G. Singh, and L. S. Bhushan.
Annals of Arid Zone, Vol 19, No 3, p 215-220, September, 1980. 1 Fig, 4 Tab, 3 Ref.

Descriptors: *Irrigation, *Wheat, *Water use efficiency, *India, Water conservation, Water harvesting, Fertilizers, Crop yield, Supplemental irrigation.

Although the subhumid region of India receives 100-200 cm of rainfall annually, 75-80% is in June-September. This pattern produces water deficiencies during the winter wheat growing season. Wheat was grown with 4 irrigation treatments: (1) no irrigation, (2) one presowing irrigation, (3) one crown root initiation stage irrigation, and (4) one presowing plus one crown root stage initiation irrigation. In the 3 years of the study wheat yield was increased by as much as 4 times by supplemental irrigation treatments as compared with the dry control. Yield improvement was greatest in the driest season, 1976-77. Water use efficiency was increased by irrigation treatments, from 7 kg grain per mm in the control to 14-16 kg grain per mm in the irrigated plots (1976-77). Fertilizer use efficiency also increased dramatically with irrigation, the greatest difference being from 3 kg grain per kg N in the control to 23 kg grain per kg N in Treatment (4) in the driest season. For the Dehradun area it is recommended that a presowing irrigation be applied to avoid evaporation and seepage losses in the storage ponds. If water is still available later in the season, a second irrigation can be applied at crown root initiation. (Cassar-FRC)
W83-03867

PLANNING FOR INCREASED CROP PRODUCTION UNDER LIMITED WATER RESOURCES IN ARID AND SEMI-ARID CONDITIONS,
Indian Council of Agricultural Research, New Delhi.
T. C. Jain.
Annals of Arid Zone, Vol 19, No 3, p 227-230, September, 1980. 2 Tab, 4 Ref.

Descriptors: *Irrigation, *Crop yields, Wheat, Barley, Grain crops, Cumin, Mustard, Taramira, Water conservation, *Arid lands, *India.

Wheat and barley crops were planted alone and with another crop (mustard, taramira, or cumin) to study yields and economic aspects under conditions of limited water resources. The experiment was conducted in loamy sand in a semiarid region of India. In all combinations there was a reduction in yield of main crops, but the yield of additional crops was good enough to compensate for the reduction in main crop. Cumin caused the greatest yield losses in the main crops. A sample irrigation schedule is given. (Cassar-FRC)
W83-03868

MOISTURE CONSERVATION EFFICIENCY OF SOME LEGUMES AND THEIR EFFECT ON THE YIELD OF RAI (BRASSICA JUNCEA COSS) UNDER RAINFED CONDITIONS,
Chandra Shekar Azad Univ. of Agriculture and Technology, Kanpur (India).
K. S. Bhatia, K. K. Srivastava, and B. Lal.
Annals of Arid Zone, Vol 19, No 1/2, p 14-18, March-June, 1980. 3 Tab, 3 Ref.

Descriptors: *Soil moisture retention, *Legumes, *Water conservation, Fallow, Rai, Moong, Urd, Cowpea, Sorghum, Crops, Crop yield, Rainfall, Cover crops, *India.

The effect on soil water conservation of planting fields with legumes in the kharif season prior to planting rai (Brassica juncea Coss) in the following rabi season was studied for two years on an alluvial sandy loam in India. The percentage of soil moisture conserved by the various treatments at harvesting of the subsequent crop were: fallow, 15.8%; urd, 12.1%; moong, 16.3%; cowpea, 10.4%; and sorghum + cowpea, 10.3%. Adding fertilizer to the legumes did not significantly affect moisture conservation. Rai yields were increased by fallow, moong, and urd treatments. (Cassar-FRC)
W83-03869

EFFECT OF DIFFERENT MULCHES ON YIELD, AND MOISTURE-USE-EFFICIENCY ON TOBACCO (NICOTIANA TABACUM),
Gujarat Agricultural Univ., Ahmedabad (India).
C. B. Shah, G. L. Maliwal, P. T. Patel, and B. P. Padhiyar.
Annals of Arid Zone, Vol 19, No 4, p 451-456, December, 1980. 4 Tab, 9 Ref.

Descriptors: *Tobacco, *Mulches, *Water use efficiency, Crop yield, Bajra stover, Water conservation, *India.

Mulching with bajra stover at 5 tons per ha immediately after establishment of tobacco seedlings on a deep loam sand was the most effective treatment for optimum water use efficiency and crop yield. Other treatments included: (1) dust, (2) polyethylene sheet, (3) wheat straw at 5 tons per ha, and (4) bajra stover at 5 tons per ha after last rain. (Cassar-FRC)
W83-03871

OPTIMUM UTILIZATION OF LIMITED WATER RESOURCES OF ARID LANDS FOR EFFICIENT CROP PRODUCTION,
Central Arid Zone Research Inst., Jodhpur (India).
H. S. Daulay, and R. P. Singh.
Annals of Arid Zone, Vol 19, No 3, p 203-213, September, 1980. 9 Tab, 3 Ref.

Descriptors: *Irrigation, *Arid lands, *Water use efficiency, Wheat, Barley, Safflower, Mustard, Legumes, *Water conservation, Fertilizers.

A crop management strategy for efficient growth of winter crops in the arid zone of India was developed by growing winter wheat, barely, mustard, safflower, and pulses under different water regimes and fertility levels on sandy loam soils. Grain/seed yields, moisture use efficiency, and water use at different growth stages were reported for several varieties of crops and low, medium, and high water regimes and fertility levels for two growing seasons. Data on yield and mositure use efficiency under conditions of limited irrigation were converted to money value of the crop at the current market price. Mustard had the highest market value (in Rs. per mm per ha), 21.3; followed by peas, 15; safflower, 12.8; barley, 12.5; wheat, 11.2; and gram, 10.7. Generally the medium fertility level was most cost efficient. (Cassar-FRC)
W83-03873

EFFECT OF ASPHALT SUB-SURFACE MOISTURE ON WATER CHARACTERISTICS AND PRODUCTIVITY OF SAND SOIL,
Central Arid Zone Research Inst., Jodhpur (India).
J. P. Gupta, and R. K. Aggarwal.
Annals of Arid Zone, Vol 19, No 4, p 445-450, December, 1980. 2 Tab, 8 Ref.

Descriptors: *Barriers, *Soil moisture retention, *Water use efficiency, Asphalt, Arid lands, Sand, Water conservation, Amobar, Evaporation, Mulches, Crop yield, Moisture profiles, Subsurface barriers, Soil-water-plant relationships.

The effects of a 2 mm thick asphalt moisture barrier (Amobar) applied about 60 cm below the surface of a sand soil were investigated with a bajra crop during the rainy seasons of 1976 and 1977. Of 200 mm of irrigation water, the soil with barrier retained 176 mm, compared with 80 mm in the control. Evaporative loss over a 30-day period after irrigation was 3-5 mm higher in barriered soil than in the control. Barriered soils contained 2-4% more moisture in the 0-15 cm layer and 2-10% more in the 15-60 cm layer than normal soils. Soil moisture tensions at 40 cm depth were generally at or below 0.1 atmosphere in barriered soils and 0.3 atmosphere in normal soils. After a 60 mm rainfall moisture storage in the barriered soil increased 40 mm more than control soil. The barrier increased mineral nitrogen in the soil after harvest by 34.6-66.7%, increased N in the grain by 22.4-32.5%, and increased uptake of N by the crop by 11.3-83.87%. Crop yields and water use efficiences were also higher in the barrier fields. Asphalt barriers are not useful in soils other than sand with good self-mulching properties or where irrigation water is saline. (Cassar-FRC)
W83-03875

PLANNING SOIL AND MOISTURE CONSERVATION IN ARID REGIONS OF RAJASTHAN,
Central Arid Zone Research Inst., Jodhpur (India).
V. C. Sharma, D. C. Joshi, and J. S. Choudhari.
Annals of Arid Zone, Vol 19, No 4, p 421-424, December, 1980. 2 Tab, 2 Ref.

Descriptors: *Water harvesting, *Soil conservation, *Farm management, Runoff, Water conservation, Agriculture, *Arid lands, Erosion control, *India, Water managment, Irrigation, Infiltration, Rajasthan.

A study of two watershed in northern Jodhpur, India, resulted in land use plans more suitable for soil and moisture conservation than the present use patterns. The Rampura watershed has deep, sandy soils, of which 107 ha is well suited and 533 ha is marginally suited for cultivation. The Balarava watershed has moderately coarse shallow soils with some rocky exposures, of which about 800 ha is well suited and 487 ha is marginally suited for cultivation. Infiltration rates are 12.1 to 28.4 cm per hour in Rampura watershed and lower (3.6 to 10.8 cm per hour) in Balarava. Moisture equivalent values are similar in soils from both watersheds. Water storage capacity is greater in deep soils in both watershed. Runoff estimations are 7 to 33 ha meter in Rampura and 18 to 118 ha meter in Balarava. It is proposed that all the uncultivable land in Rampura and over half of the uncultivable land in Balarava be used for runoff collection and direction of water to a collection point. (Cassar-FRC)
W83-03887

PREDICTING CROP PRODUCTION AS RELATED TO DROUGHT STRESS UNDER IRRIGATION,
Utah Agricultural Experiment Station, Logan.
R. J. Hanks, R. M. Hagan, R. E. Danielson, E. B. Jackson, and W. O. Pruitt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255455, Price codes: A16 in paper copy, A01 in microfiche. Utah Agricultural Experiment Station Research Report 65, (1983). 367 p, 94 Fig, 119 Tab, 40 Ref. OWRT B-176-UTAH(1), 14-34-0001-9139.

Descriptors: *Crop production, Crop yeild, *Drought, Deficit irrigation, *Irrigation requirements, Sugar beets, *Soil moisture deficiency, Evapotranspiration, Consumptive use, Soil-water-plant relationships, Soil salinity, Water quality, Soil moisture retention, Arizona, California, Colorado, Utah.

Efficient farm water management to make the best use of limited water supplies during droughts requires reliable information on crop water needs as affected by climate, weather, soil and water quality. In order to broaden the data base, a common experimental design was used to collect field data at Yuma, Arizona; Davis, California; Fort Collins, Colorado; and Logan, Utah. The sugar beet data give sucrose, fresh root and dry matter yield for five or six replicated levels of water application. Irrigations (amount and time), soil water depletion, estimated drainage, and evapotranspiration were measured by stages during the growing season. The data were used in models to evaluate the influence of water deficits on crop production, given the climatic and other site factors. Yields with total mid-season cut-off and normal full season irrigation were compared for four dates of harvest and two initial soil water regimes. Overall, a strong linear relationship was established between yield and ET for a wide variety of crops of the form (Y/Ym) = 1 - 1.3 (1 - ET/ETm). Accordingly, the most efficient water use during

drought periods is to supply water to match crop needs in a manner that minimizes drainage below the root zone and takes full advantage of stored soil water. Soil properties were found to be extremely important in determining soil moisture storage capacity, and climatic factors were demonstrated to be important because cool soils lead to shallower roots.
W83-03904

MOVEMENT OF WATER AND NITRATE-NITROGEN IN A TYPICAL SILT LOAM SOIL OF WESTERN KANSAS,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5G.
W83-03908

WATER CONSERVATION BY OPTIMAL IRRIGATION SCHEDULING BASED ON CORN DYNAMIC GROWTH MODEL,
Kansas Water Resources Research Inst., Manhattan.
E. S. Lee, A. W. Biere, and E. T. Kanemasu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256743, Price codes: A03 in paper copy, A01 in microfiche. Contribution No 236, March 1983. 34 p, 11 Fig, 9 Ref. OWRT A-107-KAN(1), 14-34-0001-2118.

Descriptors: *Corn, *Irrigation scheduling, Evapotranspiration, Crop response, *Water conservation, Model studies, Nebraska, Data collections, Kansas.

It is argued that improved irrigation scheduling techniques are important to improving water conservation and that improved irrigation scheduling is dependent upon better knowledge of a crop's response to irrigation. Reported are the results of estimating a dynamic crop response model using as extensive set of experimental data. The crop response model to be tested here has been estimated previously using data collected in Kansas. This study estimates the model using data collected in Nebraska. Thus, we have used data totally unrelated to the Kansas data used earlier. A portion of these new data were used earlier to test the model. The dynamic crop response function was estimated for three alternative formulations as a piece-wise linear function. The shape of the functions obtained are fairly consistent with each other and reasonably consistent with the function estimated earlier from Kansas data. The 'goodness of fit' of the alternative functional forms was not as good as anticipated. The estimated two segment piece-wise linear function had the best fit explaining 56% of the squared variations in yield. This study is the most extensive test to date of the dynamic crop response model we have developed.
W83-03917

DISCUSSION: OPTIMIZATION OF WATER RESOURCES FOR IRRIGATION IN EAST JORDAN, BY JANUSZ R. RYDZEWSKI AND HANI A-H. RASHID,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter.
Water Resources Bulletin, Vol 18, No 6, p 1043-1044, December, 1982. 1 Ref.

Descriptors: *Irrigation, *Water allocation, *Jordan, Water conservation, Water management.

A discussion on the above titled paper, published in Water Resources Bulletin, 17(3):367-372, June, 1981, derives a new formulation for determining the optimum level of irrigation water application. Although more variables and constraints are required, the number of linear programs is reduced from several to only one. Results of the improved formulation more correctly describe the physical system. (Cassar-FRC)
W83-03936

YIELD RESPONSE OF CORN AND SOYBEANS TO IRRIGATION AND DRAINAGE ON A CLAYPAN SOIL,
Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.
P. N. Walker, M. D. Thorne, E. C. Benham, and S. K. Sipp.
Transactions of the ASAE, Vol 25, No 6, p 1617-1621, November/December, 1982. 2 Fig, 6 Tab, 4 Ref.

Descriptors: *Crop yield, *Irrigation effects, *Drainage effects, Furrow irrigation, Sprinkler irrigation, Subsurface drainage, Surface drainage, Corn, Soybeans, Clays, Comparison studies.

Each of forty field plots having claypan soil received one of ten combinations of irrigation and drainage treatments. Each treatment was repeated twice for corn corps and twice for soybean crops. Yield data were maintained for 5 years for corn and 2 years for soybeans. The irrigation treatments were sprinkler, furrow, and no irrigation. The drainage treatments were surface, subsurface, surface plus subsurface, and no drainage. A solid set system was used for the sprinkler irrigation, and gated pipes were used for the furrow irrigation. The plots with surface drainage had a slope of 0.5%, while the others were graded level. Subsurface drainage was provided with plastic tubing on 6 meter centers. The data indicate that both irrigation and drainage result in increased corn yields on claypan soils in Illinois. Soybean crops were not as responsive as corn to irrigation and appeared to derive only a minimal benefit from drainage. Corn yields were increased by 0.8 tons per hectare by drainage alone and 2.4 tons per hectare by irrigation alone. Use of irrigation and drainage together resulted in an average increase of 4.8 tons per hectare, indicating that irrigation and drainage increase yield synergistically. The sprinkler and the furrow methods of irrigation were found to have the same effects on yield. The three types of drainage tested also appeared to have the same effects on crop yields. (Carroll-FRC)
W83-03956

DISCRETE-TIME, CUTBACK FURROW IRRIGATION,
Oregon State Univ., Corvallis. Dept. of Electrical and Computer Engineering.
S. L. Lillevik.
Transactions of the ASAE, Vol. 25, No 6, p 1646-1650, November/December, 1982. 7 fig, 9 ref.

Descriptors: *Furrow irrigation, *Automation, *Irrigation efficiency, Irrigation operation, Irrigation-return flow, Computers.

A prototype automated furrow irrigation system as been developed and tested at Utah State University. The system uses a microcomputer to control pneumatic valves and water distribution in each furrow with a gated pipe system. Rather than using several-sized control valves to achieve cutback, discrete-time cutback uses in single valve which modulates the flow rate to each furrow. Cutback furrow irrigation involves the application of water to individual furrows in two phases. In the first phase, water is applied at a constant 'wetting' flow rate, while in the second phase, this initial flow rate is reduced accofding to an experimentally determined curve of flow rate versus time. Discrete-time control eliminates of reduces problems with previous cutback systems by implementing cutback through varying the duty-cycle of the flow rate and not the rate itself. For a modulated flow rate at a fixed frequency, the duty-cycle represents the ratio of water flow to total perios. As time progresses, the duty-cycle of each furrow decreases to provide an averaged cutback. Runoff data collected from a group of test furrows and averaged to determine the cutbavk profile indicated relatively little runoff, while achieving uniform wetting of the soil of each furrow. (Carroll-FRC)
W83-03958

BORDER DITCH IRRIGATION IN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
F. T. Izuno, W. Clyma, and T. H. Podmore.
Transactions of the ASAE, Vol 25, No 6, p 1612-1616, 1621, November/December, 1982. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Border irrigation, *Irrigation ditches, *Irrigation efficiency, Irrigation operation, Irrigation practices, Agriculture, *Colorado.

Border ditch irrigation is controlled version of wild flooding which is used to many Colorado farmers to irrigate close growing crop. This method is a labor intensive form of surface irrigation which is most appropriate for crops with deep root zones and large water requirements. Use of this method requires an irrigator who has experience gained from trial and error experimentation on the particular field. Management evaluations of two fields on a Colorado farm showed application efficiencies between 25 and 45%, requirement efficiencies between 90 and 100%, and deep percolation ratios between 0.20 and 0.65. Although border ditches are approximately used on fields with cross slopes, these cross slopes make it difficult to achieve uniform irrigations. Irrigation uniformity is poor near the ditches, but improves as distance from the border ditch increases. Management variables that have the most effect on achieving an effective and uniform irrigation are location of border ditch applications, flow rates and durations, and the magnitude of the water requirement at the time of irrigation. Farmers continue to use border ditch irrigation because of tradition, their belief that the system works, a lack of knowledge of alternatives, and favorable economics. (Carroll-FRC)
W83-03959

ECONOMIC OPTIMIZATION OF IRRIGATION,
Oregon State Univ., Corvallis.
M. J. English, A. G. Nelson, B. C. Nakamura, K. C. Nielsen, and G. S. Nuss.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265140, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-80, Oregon State Univ., Corvallis, March 1983. 141 p, 5 Fig, 19 Ref, 6 Append. OWRT A-049-ORE(1), 14-34-0001-2139.

Descriptors: Irrigation, *Irrigation design, *Irrigation efficiency, Irrigation operation, Irrigation practices, *Irrigation requirements, *Irrigation scheduling, *Deficit irrigation, Irrigation performance, *Optimization, *Marginal costs, Costs, Operating costs, Economic aspects, Design criteria, Design techniques, Crop yield, Risks, Soil moisture deficiency, Evapotranspiration.

Optimization of irrigation system design, planning and operations is explored with focus on the use of deficit irrigation (deliberate underirrigation of crops) under operating circumstances. Deficit irrigation involves a radical philosophical departure from conventional practice, based on the axiom that water use should be reduced to where the marginal cost of irrigation just equals the value of the increment of yield. Implications of this axiom are explored. A case study is presented in which the marginal costs of irrigation are examined. Irrigation system design is more complex with deficit irrigation because the designer has more latitude and system performance is more difficult to predict. Design techniques for exploiting the concept of deficit irrigation are explored and an algorithm for predicting system performance outlined. Risk becomes a significant question when crops are underirrigated, partly because of difficulties in predicting yields. Irrigation scheduling is also a more important consideration under deficit irrigation. Crop variability and crop stress may be greater and more uncertain under deficit irrigation. The problem of scheduling for deficit irrigation is examined and scheduling using mathematical filtering techniques is proposed. Field research on irrigation frequency versus crop yield and evapotranspiration under low soil-moisture conditions show these to be significant considerations in irrigation optimization.
W83-04007

DEFICIT, HIGH-FREQUENCY SPRINKLER IRRIGATION OF WHEAT,
Washington State Univ., Pullman. Coll. of Agriculture Research Center.
D. E. Miller, and A. N. Hang.

Soil Science Society of America Journal, Vol 46, No 2, p 386-389, March/April, 1982. 1 Fig, 4 Tab, 20 Ref.

Descriptors: *Crop yield, *Irrigation practices, *Sprinkler irrigation, Irrigation, Water supply, Soil water, *Wheat, Evapotranspiration, Moisture availability, *Washington, Moisture deficit.

The minimum daily sprinkler irrigation rate that would not reduce wheat yields on medium- and coarse-textured soils was determined. Studies were conducted on sandy and loam soils with greatly differing water holding characteristics. Grain yields on loam soil at Prosser increased with evapotranspirate (ET) rates up to about 40 to 45 cm for the period after the line source was installed. Yields did not significantly increase with increased ET beyond this range. Soil-water samples were taken at two-week intervals during the irrigation season. Water losses from the soil plus irrigation were compared to estimated ET rates. On the sand, the yield and quality of wheat increased with increased application of water, up to about 100% estimated ET. On the loam soil, daily irrigations which equaled or exceeded 40% estimated ET produced similar yields. On this soil, the total water used, including water depleted from the soil, also varied over a wide range without affecting yields. (Baker-FRC)
W83-04032

COMMENTS ON 'A TRICKLE IRRIGATION SYSTEM FOR FREQUENT APPLICATION OF NITROGEN TO EXPERIMENTAL PLOTS', AND REPLY TO COMMENTS,

Hawaiian Sugar Planters' Association, Aiea. Crop Science Dept.
R. P. Bosshart, and L. T. Santo.
Soil Science Society of America Journal, Vol 46, No 5, p 1121-1122, September/October, 1982. 1 Ref.

Descriptors: *Irrigation programs, *Nitrogen, Fertilizer, Irrigation, Water supply, Water demand, Crop yield, *Trickle irrigation.

In their comments on the original paper (Hairston, J. E., Schepers, J. S., and Colville, W. L., Soil Science Society of America Journal, Vol 45, p 880-882, 1981) the current authors take exception to the fact that the paper was printed as a full-scale paper rather than as a technical note, citing the lack of precise data and shortcomings of the measurements taken. The paper had presented a simple system which provided good water and fertilizer distribution to small scale plots, but failed to mention the trickle tube's orifice spacing and diameter or any device for measuring the amount of water applied. No mention was made of the effect of a water applied x nitrogen interaction on yield. Water distribution efficiency was not measured; nitrogen analyses were used to evaluate fertilizer distribution, but the form of nitrogen was not stated. In their response to these comments the original authors expressed their desire to present a simple system for use on small-scale plots rather than large field scale commercial plots. The biwall trickle tube used in the study had 1 mm holes spaced 1.5 m apart on the inside tubing and 30 cm apart on the outside tubing. Orifice plugging related to microbial growth was eliminated by turning the trickle tubing upside down, keeping the orifices out of contact with the soil. The N source used was ammonium nitrate. (Baker-FRC)
W83-04033

FIELD MEASUREMENT OF DENITRIFICATION: III. RATES DURING IRRIGATION CYCLES,

California Univ., Davis. Dept. of Land, Air and Water Resources.
D. E. Rolston, A. N. Sharpley, D. W. Toy, and F. E. Broadbent.
Soil Science Society of America Journal, Vol 46, No 2, p 289-296, March/April, 1982. 9 Fig, 2 Tab, 18 Ref.

Descriptors: *Irrigation practices, *Denitrification, Nitrogen, Nitrogen oxide, Leaching, Fertilizers, Water supply, Soil water, *California.

The fluxes of nitrogen and nitrogen oxide gases were directly measured from a fertilized field soil as influenced by three different irrigation frequencies and two levels of carbon in order to understand the dynamic nature of denitrification during field wetting and drying cycles. Denitrification measured directly from nitrogen and nitrogen oxide gas fluxes from N-15 enriched fertilizer was also compared with that measured directly using the acetylene inhibition method. Small fluxes of denitrification gases were measured in this well drained alluvial soil under normal cyclic applications of irrigation water. Total denitrification ranged from .07 to 5% for the least frequently irrigated and most frequently irrigated plots, respectively. Surface denitrification gas fluxes were largest after the first irrigation, decreased to near zero values within 1 or 2 days after each irrigation, and generally decreased for subsequent irrigations. The amount of nitrogen produced was much greater than that of nitrogen oxide. The nitrous oxide flux at the soil surface varied between 5 and 27% of the total denitrification over a 40- to 50-day period. Nitrous oxide mole fractions tended to be smallest immediately after irrigation and increased as the soil water redistributed and the soil profile became less anoxic. The irrigation frequency of three irrigations per week gave higher soil nitrate content within the root zone of the crop than those of the other two frequencies. Thus, frequent, small irrigations may result in smaller leaching losses than infrequent, large irrigations. (Baker-FRC)
W83-04035

TIME AND FREQUENCY OF IRRIGATION EFFECTS ON SUNFLOWER PRODUCTION AND WATER USE,

Texas Agricultural Experiment Station, College Station.
P. W. Unger.
Soil Science Society of America Journal, Vol 46, No 5, p 1072-1076, September/October, 1982. 3 Tab, 28 Ref.

Descriptors: *Water conservation, *Irrigation programs, Plant growth, Crop yield, *Sunflowers, Irrigation, Water use, Water demand, *Texas.

The effect of irrigation at readily identifiable growth stages on sunflower growth, seed yield, seed oil percent, linoleic and oleic acid concentrations of oil, total water use, WUE (total and irrigation) was determined. The relationships between water use and seed yield, seed quality factors, and oil percent and composition were also measured. Treatments providing one or two irrigations at identifiable growth states were compared with treatments providing no, adequate, and full irrigation. Sunflowers irrigated before flowering averaged 17 cm taller than those not irrigated between emergence and flowering. Seed yields averaged highest with full irrigation, but in individual years, differences between full irrigation and other treatments were not always significant. Usually the highest seed yield resulted from flowering or late flowering irrigations. These irrigations usually also resulted in the highest seed test weight and weight/seed. Oil percent averaged highest for the emergence plus late flowering irrigation treatment and lowest with the emergence plus budding treatment. Irrigation treatments significantly affected linoleic and oleic acid concentrations of the oil, but the maximum difference among treatments was only four and five percentage units for linoleic and oleic acids, respectively. Total water use increased with increased number or irrigations, but yield increases were not proportional to water use, especially for the adequate and full irrigation treatments. With these treatments water use efficiency was less than for limited irrigation treatments that provided adequate water from flowering to later flowering. (Baker-FRC)
W83-04039

EFFECT OF DRY-SEASON SOIL MANAGEMENT OF WATER CONSERVATION FOR THE SUCCEEDING RICE CROP IN A TROPICAL SOIL,

International Rice Research Inst., Los Banos, Laguna (Philippines). Dept. of Agronomy.
S. S. Hundal, and S. K. De Datta.
Soil Science Society of America Journal, Vol 46, No 5, p 1081-1086, September/October, 1982. 7 Fig, 16 Ref.

Descriptors: *Water conservation, *Crop yield, Rice, Tropical regions, Soil management, Water management, Water demand, Soil temperature, Temperature, Mulching, Straw mulch, Tillage, Fallow tillage, *Phillipines.

Soil water conservation measures were evaluated during the fallow period of January to May in the tropical rice growing region of the Philippines. The field study was conducted on Alfisol (isothermic, clayey mixed Aquic Tropudalf) derived from volcanic materials. The field site was wet plowed and puddled, and transplanted rice was grown in the preceding wet season of 1979. At the beginning of the 1980 dry season five fallow soil management systems were established: rotovated, plowed and rotovated, herbicide treated-straw mulched, herbicide treated-bare soil, and weedy control. Highest soil temperatures were obtained in the bare soil treatment. The straw mulch application maintained the lowest temperatures. By the end of the dry season, the soil had dried to the 1 meter depth in the weedy control compared to 15 cm in soil mulch, 30 cm in straw mulch, and 45 cm in the bare soil treatment. Starting with initial soil water contents close to field capacity, a maximum water depletion of 248, 86, 55, 35, and 58 mm occurred in the weedy control, bare soil, straw mulch, plowed and rotovated, and rotovated treatments, respectively, at the end of the dry season. Groundwater tables during this period varied from about the 1.5 to 1.75 m soil depth. Rainfall requirement was significantly reduced and early crop establishment was made possible when soil was kept weed-free during the dry-season fallow. Minor differences in water conservation occurred among soil mulch, straw mulch, and bare soil systems. (Baker-FRC)
W83-04066

DESIGN FOR A FIELD SPRINKLER INFILTROMETER,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia).
S. J. Zegelin, and I. White.
Soil Science Society of American Journal, Vol 46, No 6, p 1129-1133, November/December, 1982. 7 Fig, 15 Ref.

Descriptors: *Sprinklers, *Design criteria, *Rainfall simulators, Sprinkling, Irrigation, Water supply, Field investigations, Infiltration, Rainfall-runoff relationships, Soil water.

A simple, inexpensive, and portable sprinkler infiltrometer is described which fulfills the requirement that the application of water be uniform over the sample plot and that the soil surface remain relatively undisturbed during infiltration by the size and energy of the water drops. The sprinkler infiltrometer described uses air pressure to drive water through an interchangeable nozzle onto the field plot. Application rates with uniform distribution are selected by electronically pulsing a solenoid valve between the pressurized water supply and the nozzle. A simple field experiment was performed to demonstrate the use of the sprinkler infiltrometer. Two application rates, 10 and 15 mm/hr, were tested. It was concluded that the infiltrometer provided an efficient, rapidly assembled and economical means of applying water uniformly to field plots at a selectable range of reproducible constant rates. Because the energy supply is a 12 V battery and a compressed air cylinder and because the water supply reservoir is separated from the delivery nozzle, the infiltrometer is easily and quickly transportable. (Baker-FRC)
W83-04072

EFFECT OF IRRIGATIONS SCHEDULED AT DIFFERENT STAGES OF GROWTH ON SEED PRODUCTION OF OAT,

Indian Grassland and Fodder Research Inst., Jhansi.
N. P. Shukla, S. B. Hukkeri, and M. Lal.
Indian Journal of Agricultural Sciences, Vol 52, No 12, p 837-840, 1982. 1 Tab, 4 Ref.

Descriptors: *Irrigation, *Crop yield, Oat, India, Irrigation programs, Soil properties, Moisture availability, Plant growth, Water conservation.

During the winters of 1971-72 and 1972-73 a field experiment was conducted at Jhansi, Uttar Pradesh, to study the effect of irrigations scheduled at different stages of growth on seed production of oats on loamy soil. The soil had a pH of 7.5. The quantity of moisture per meter depth of soil at field capacity was 30.8 cm and at the wilting point 8.5 cm. The pre-sowing irrigation of 5 to 6 cm water was given for seed-bed preparation in both years. The irrigations after sowing were in accordance with the treatments. The quantity of water applied at each irrigation was measured. Pooled data revealed that the seed yield of oat increased with increase in irrigation frequencies up to 3, but the yield differences due to 3 irrigations, 4 irrigations, 5 irrigations, and 6 irrigations were statistically non-significant. The increase in the yield due to 1 irrigation applied at the initiation of tillering and of 2 or more irrigations over that of no irrigation after sowing was statistically significant. There was some difference in the response to irrigation in different years. In the first year, 2 irrigations applied at late tillering and flowering gave seed yields on par with those due to 6 irrigations. Pooled data indicated that yield due to 3 irrigations applied at the initiation of tillering, jointing and milk was only on a par with that due to 6 irrigations, indicating that irrigations at these three physiological stages were adequate for satisfactory seed production. The effect of irrigation on straw yield was significant only in the first year. Higher straw production was recorded with 5 irrigations. Frequent irrigation during the vegetative phase of the crop can increase and synchronize the growth and development of tillers and thus increase the straw production. (Baker-FRC)
W83-04087

NOTE ON THE USE OF IRRIGATION WATER AND YIELD OF TRANSPLANTED RICE IN RELATION TO TIMING OF LAST IRRIGATION,
Punjab Agricultural Univ., Ludhiana (India).
B. S. Sandhu, K. L. Khera, and B. Singh.
Indian Journal of Agricultural Sciences, Vol 52, No 12, p 870-871, 1982. 1 Tab, 5 Ref.

Descriptors: *Irrigation, *Rice, *Crop yield, Irrigation practices, Water supply, Water conservation, Straw, Soil properties, Moisture availability.

A field experiment was conducted during 1976-78 with 'Jaya' rice transplanted on a puddled sandy-loam soil. The field capacity and 15-bar water storage in 180-cm soil profile were 40 cm and 14.3 cm, respectively. Bulk density of the soil in the profile varied from 1.48 to 1.55 g/cu cm. In the five irrigation treatments used the last irrigation to the crop was terminated at different times before its harvest. Compared with the conventional practice of a 7-day cut-off period, suspension of the last irrigation 14-17 days before harvest did not decrease the grain yield, but allowed a saving of 16 cm irrigation water. After cutting off the irrigation early, the crop ripened relatively more uniformly and 2-3 days earlier. Termination of irrigation 21-22 days before harvest decreased the yield insignificantly. This practice effected an additional economy of 22 cm water, which is useful where irrigation water supplies are limited. Rapid decline in grain yield beyond 21-24-day cut-off periods may be attributed partly to the corresponding significant increase in floret sterility. The number of effective tillers was not influenced by the time range of last irrigation studied. Unlike grain yield, the straw yield did decrease significantly even when the irrigation was stopped 14-17 days before harvest. Stoppage of irrigation for 14-17 days also reduced the average moisture content of fresh paddy grain from 26.2 to 20.8%; since 20% is the highest permissible limit for marketing, this cut-off period also facilitates immediate disposal of produce in the market with no need for storage. It is thus concluded that on sandy-loam and on heavier non-cracking and non-saline soils, the last irrigation to rice can be safely applied 2 weeks before its harvest. (Baker-FRC)
W83-04088

NOTE ON THE EFFECT OF SUBSOIL SODICITY ON THE WATER USE BY IRRIGATED WHEAT,
Central Soil Salinity Research Inst., Karnal (India).
C. L. Acharya, S. S. Sandhu, and I. P. Abrol.
Indian Journal of Agricultural Sciences, Vol 52, No 12, p 872-873, 1982. 1 Tab, 4 Ref.

Descriptors: *Irrigation, *Crop yield, *Wheat, Water supply, Irrigation practices, Water conservation, India, Soil properties.

An evaluation was made of the water use under different irrigation schedules for wheat grown in gypsum-treated and untreated plots of a highly sodic soil that had been under rice-wheat rotation for the past 8 years. The treated plots received gypsum in the summer of 1970 at about 15 tonnes/ha, mixed in the surface layer. Exchangeable sodium percentage at the time of the study was less than 20 up to 50 cm depth in the gypsum-treated plots, but more than 20 below 25 cm depth in the untreated plots. Wheat 'HD 2009' was seeded by drill in November 1978 in rows 30 cm apart and harvested in April. Three irrigation treatments corresponding to 5 cm of irrigation, each time after 40, 60, and 80 mm of cumulative open-pan evaporation, were imposed under both gypsum treated and non-treated plots. These were replicated four times. With a reduction in irrigation frequency, more water was contributed from the 90 cm profile for crop growth. Further, the gypsum-treated plots contributed more water from the profile than the control plots. For plots receiving irrigation after 80 mm of cumulative evaporation, the contribution of profile water from the time the crop was seeded until the time of harvest in the gypsum-treated plots was 6.8 cm, compared with 3.7 cm in the coontrol plots. However, under the high irrigation frequency there was practically no difference in the contribution of profile water in the gypsum-treated and the untreated plots. Grain yield was unaffected by irrigation frequencies, mainly because of well distributed rain occurring during the season. The grain yield was also unaffected owing to differences in subsoil sodicity. (Baker-FRC)
W83-04089

THE INFLUENCE OF WATER AVAILABILITY ON WINTER WHEAT YIELDS,
Kansas Agricultural Experiment Station, Manhattan. Evapotranspiration Lab.
R. C. Johnson, and E. T. Kanemasu.
Canadian Journal of Plant Science, Vol 62, No 4, p 831-838, 1982. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Moisture availability, *Crop yield, *Drought, Water supply, Soil moisture, Soil water, Wheat, Kansas.

Yield and yield components of winter wheat grown under different soil water conditions were compared through field experiments. Precipitation was excluded from a 150 sq mile plot area so as to control soil water. Treatment regimes were described according to their relative preanthesis/postanthesis soil water content as high/high (H/H), high/low (H/L), low/high (L/H), and low/low (L/L). Soil water to the depth of 150 cm was monitored through use of a neutron probe. Plot yields ranged from 559 g/sq m in regime H/H to 267 g/sq in L/L and were positively correlated with head number per square meter and kernel number per head. Low preanthesis oil water reduced head number per sq m in both years. Regimes L/H and L/L had reduced kernels per spikelet compared to regimes with high preanthesis soil water. Increased kernel weight was associated with low preanthesis soil water. It is concluded that if a drought develops before grain filling in the spring,improved tiller survival and/or floret fertility could increase yields, even if some stress continued through grain filling. Under nonstress conditions, yield appears limited most seriously by the amount of assimilate required to fill a high number of kernels per sq meter. If limited amounts of water are available for spring irrigation, the maximum positive effect on yield can probably be obtained by preanthesis water application. (Baker-FRC)
W83-04102

EVALUATING LOW-VOLUME IRRIGATION SYSTEMS FOR EMISSION UNIFORMITY,
D. Handley, H. J. Vaux, Jr., and N. Pickering.
California Agriculture, Vol 37, No 1/2, p 10-12, 1983. 5 Fig, 1 Tab.

Descriptors: *Irrigation practices, *Design criteria, Irrigation engineering, Trickle irrigation.

The uniformity of discharge by low-volume irrigation systems in the field under normal operating conditions was evaluated. The evaluation was performed for 112 low volume systems on 40 ranches in the southern San Joaquin Valley. The sample included 15 different emission devices being used on nine perennial crops. The systems varied in age from 6 months to 10 years. For systems that have been in operation for one or more seasons, emission uniformities greater than 90% are regarded as excellent, between 80 and 90% as good, between 70 and 80% as fair, and below 70% as poor. About 62% of the systems evaluated were operating in the good-to-excellent range, and 38% in the fair-to-poor range. About half the problems experienced in systems demonstrating low uniformities were associated with pressure differences and half had emitter variability problems caused by factors other than pressure. In most systems the system emission uniformity was significantly lower than the test emission uniformity. Sixty percent of the pressure-related problems were attributable to poor pressure regulation. In many cases uniformity was improved by valve or regulator adjustments at manifold inlets. There was no detectable relation between the age of the system and emission uniformity. This suggests that performance over time is primarily a function of the adequacy of design and maintenance rather than physical deterioration of the system (Baker-FRC)
W83-04111

INCIDENTAL EFFECTS OF AGRICULTURAL WATER CONSERVATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
D. C. Davenport, H. J. Vaux, Jr., and R. M. Hagan.
California Agriculture, Vol 37, No 3/4, p 28-31, March/April, 1983. 1 Tab.

Descriptors: *Irrigation effects, *Agriculture, *Conservation, Benefits, Water conservation, Water quality, Economic aspects, Water rates.

The incidental effects of agricultural water conservation can be beneficial or adverse. A water conservation practice may have multiple and complex effects. For example, reduction in applied irrigation water may diminish crop yield (adverse) and decrease energy and fertilizer needs (beneficial). A table lists 23 categories (e.g., drainage disposal, fertilizers and nutrients, groundwater depth, instream needs, soil physical properties, and water quality), the water conservation actions (e.g., changes in irrigation methods or irrigation water quality, wastewater reuse, mulching, lining canals, land levelling), the incidental effects (e.g., reduction in erosion and runoff, salt buildup, decrease in groundwater recharge, decrease in stream water quality, decrease in volume of drainage water), and the on-farm and off-farm adverse or beneficial effects of each. Artificially low water prices complicate economic assessment of the external impacts of water conservation measures. Water scarcity and high water prices are the real motivating forces behind water conservation in irrigated agriculture. (Cassar-FRC)
W83-04113

EFFECT OF MULCHES ON MOISTURE AND THERMAL REGIMES OF SOIL AND YIELD OF PEARL MILLET,
Central Arid Zone Research Inst., Jodhpur (India).
J. P. Gupta.
Annals of Arid Zone, Vol 19, No 1-2, p 132-138, March-June, 1980. 1 Fig, 4 Tab, 5 Ref.

Descriptors: *Soil water, *Mulching, *Crop yield, *Water use efficiency, *Hydrothermal studies, Mulches, Semiarid lands, Arid lands, Consumptive use, Polymers, Soil temperature, Loam, Millet.

Mulches play an important role in changing the hydrothermal regime of soil and conserving soil moisture for the growth of plants in arid and semiarid regions. The effects of polyethylene and bajra husk mulches on the growth and yield of pearl millet were studied in field experiments. Soil samples were collected from different depths during crop growth, and soil moisture was determined gravimetrically on 3 m by 2 m plots mulched with 6 tons/ha of polyethylene sheet (400 gauge) or bajra husk mulch. Soil temperature was measured with Aplab telethermometers using probes, and consumptive water use was calculated from soil moisture data, taking rainfall into consideration. After harvest, crop, grain, and straw yield was recorded for each plot. Soil mean maximum temperature was lower under bajra husk mulch than under polyethylene, but a significant decrease in temperature with depth was noted under the latter. Maximum grain yield of pearl millet was obtained from soil mulched with polyethylene, followed by bajra husk, then by control plots with water use efficiencies of 10.4, 8.5, and 6.0 kilograms/mm/ha, respectively. (Geiger-FRC)
W83-04120

ANALYSIS OF THE PLANT SOIL CONTINUUM USING ELECTROPHYTOGRAMS, PHASE II,
Arizona Univ., Tucson. Dept. of Electrical Engineering.
W. Gensler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105345, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Arizona, Tucson, December 1982. 41 p, 12 Fig, 26 Ref. OWRT B-089-ARIZ(1), 14-34-0001-0205.

Descriptors: *Irrigation efficiency, Water conservation, *Water status measurement, Remote sensing, *Plant growth, *Electrochemical sensors.

The primary objective of this project is the development of a direct electrochemical sensing of plant water status in the field by means of electrochemical techniques. A further objective is the transmission of this information to the grower in a form which permits irrigation scheduling. The basic plant electropotential responses to a water stressed and unstressed condition have been determined. These responses have been converted by means of an algorithum into a numerical index of water status. An experimental telemetry system has been constructed to transfer the information to a central site for processing. This system is operational. In addition, a fourth generation telemetry system was designed and is partially completed, which incorporates all the experience gained working with the original system. This latter system is amenable to very large scale usage.
W83-04136

INCREASED WATER CONSERVATION AND PERCOLATION THROUGH IMPROVED TILLAGE PRACTICES,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
H. D. Wittmuss.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105584, Price codes: A03 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, (1983). 28 p, 7 Fig, 8 Tab, 4 Ref. OWRT A-069-NEB(1), 14-34-0001-2129.

Descriptors: *Water conservation, Cultivation, *Deep percolation, Soil moisture, *Soil water storage, Model studies, Root zone, *Nebraska, Irrigation practices, *Tillage systems.

A technique was developed to determine soil water storage and predict deep percolation under different tillage treatments and moisture levels. The dryland farmer can use the findings to vary his tillage practices to conserve the maximum amount of moisture for increased crop production. The irrigation farmer can use the findings to vary his tillage practices to increase deep percolation from rainfall to increase groundwater storage. A model was developed to predict deep percolation below the root zone based on the ratio of actual soil moisture content of the soil in the root zone to the saturated moisture of the soil (degree of saturation) and some parametric constants depending on soil type. The amount of water stored in the root zone increased gradually during the growing season. The effect of tillage systems on soil water storage were not significant; however, orthogonal contrast showed some significant differences among treatments. There were no significant differences in deep percolation or crop yields among overall tillage treatments.
W83-04160

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

THE ESSENCE OF MATHEMATICAL MODELS OF RESERVOIR STORAGE,
National Hydrology Research Inst., Ottawa (Ontario).
V. Klemes.
Canadian Journal of Civil Engineering, Vol 9, No 4, p 624-635, December, 1982. 6 Fig, 24 Ref.

Descriptors: *Reservoir storage, *Model studies, Reservoir operation, Storage, Reservoir design, Mathematical models.

The proliferation of applied reservoir storage models has been a result of unrecognized redundancies, permitting variations of known models to be considered as new models. Causes of this situation are language barriers, specialized jargons, and limited understanding of published work. The essence of reservoir storage models is the recursive application of simplified equations of motion, the continuity and dynamic equations. A detailed analysis of four reservoir routing models and a demonstration of the fact that reservoir routing and forced regulation differ only in the choice of the second independent variable illustrate these relationships. The first independent variable is inflow, the second is the parameter(s) of the routing function for routing models and reservoir outflow or storage for forced regulation models. (Cassar-FRC)
W83-03852

INTEGRATED CONTROL OF COMBINED SEWER REGULATORS,
Montreal Urban Community (Quebec).
For primary bibliographic entry see Field 5G.
W83-03862

DRAINAGE REQUIREMENTS OF SALT AFFECTED SOILS,
Central Soil Salinity Research Inst., Karnal (India).
D. V. V. Narayana.
Annals of Arid Zone, Vol 19, No 3, p 259-263, September, 1980. 4 Tab, 5 Ref.

Descriptors: *Drainage systems, *Saline soils, *Water storage, Drainage engineering, Drainage wells, Subsurface drainage, Surface drainage, *India, Storage, tile drainage, Wells.

Saline soils in India are divided into four groups, depending on location and type of soil (alkali, organic, arid, coastal, etc.). Most are poorly drained. Surface drainage, horizontal subsurface drainage, and vertical drainage (drainage wells) have been used in various regions. Most existing surface drainage systems are underdesigned. However, the integrated three-tier system in Karnal has successfully coped with both heavy rainfall and drought conditions. It consists of collecting part of the rainfall in the cropland, directing excess rainwater to dugout ponds for storage, and draining remaining water into the regional drainage channels. Subsurface drainage, expensive to install, has not been proved necessary in this region. Vertical drains have been successful in lowering groundwater levels in areas where an aquifer with good water quality and sufficient supplies exists within 12-20 m from the surface. (Cassar-FRC)
W83-03886

OPTIMAL CONTROL OF THE CASPIAN SEA LEVEL,
M. S. Markish.
Water Resources (English Translation), Vol 9, No 2, p 122-136, March-April, 1982. 5 Fig, 4 Tab, 12 Ref. Translated from Vodnye Resursy, No 2, p 20-35, March-April, 1982.

Descriptors: *Sea level, *Statistical models, *Caspian Sea, Modeling, Mathematical studies, Evaporation, Water level, Flow control, Alternative planning, *USSR.

A refined and generalized problem of optimal control of a closed water body is presented with reference to the Caspian Sea. The approach takes into account the autocorrelation of the series of the natural annual flow to the sea and apparent evaporation from its surface, the random variability of the maximum volume of additional controlled inflow, and the possibility of cutting off certain parts of the water area of the sea to reduce total evaporation from its surface. Under the investigating conditions it was proved that the optimal control strategy when using a model with continuous time is a relay strategy with a unique switching point. An algorithm for calculating the optimal relay strategies and characteristics of the controlled regime of the sea was developed and realized on a computer. Calculation of equivalent strategies providing the prescribed stability of the level with a minimum average additional inflow is also possible. Optimal control of the Caspian level was calculated for different variants. It was shown that optimal control provides greater stability of the level with a smaller value of the average additional inflow compared to the annual delivery of constant volumes of water to the sea. Dependences of the stability of the level and use factors of the additional inflow on the maximum volume of the latter and value of the nonreturnable water consumption were obtained. These same characteristics were calculated under conditions of cutting off the shoals. The effect of other factors was also determined. The adequacy of the mathematical model used for the prototype and its completeness were substantiated by statistical tests. The method can be used for calculating the control level not only of the Caspian Sea but also of other large natural water bodies. (Baker-FRC)
W83-03949

ESTIMATING THE POTENTIAL FOR OCHRE CLOGGING BEFORE INSTALLING DRAINS,
Agricultural Research and Education Center, Lake Alfred, FL.
H. W. Ford.
Transactions of the ASAE, Vol 25, No 6, p 1597-1600, November/December, 1982. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Iron bacteria, *Iron, *Drains, *Clogging, Bacteria, Soil water, Soil porosity, Soil types, Soil bacteria, Soil solution, Chemistry of precipitation, Oxidation-reduction potential, Laboratory studies, Drainage.

Ochre, a gelatinous red to tan iron deposit in subsurface drains, can cause failure by clogging synthetic and gravel envelopes, water inlet openings, and the internal volume of drains. Ochre development depends on a source of ferrous iron Fe(II) flowing into the drains, the presence of reducing bacteria, and a source of organic carbon energy for the bacteria. Energy requirements will vary with soil type and characteristics of the iron on soil particles. Test procedures have been developed which can be used to estimate ochre potential in agricultural drains and in drains in wastewater management sites, highways, and landfills. The procedures involve estimation of the levels of Fe(II) that may occur in the soil solution (groundwater), using either soil samples incubated in the laboratory or groundwater tested directly in the field. The field portion of the procedure consists of

separating Fe(II) from the groundwater using a closed pressure filtraton through 0.45 micrometer disc filters into sulfamic acid, where the Fe(II) is stable for several days. The laboratory procedure utilizes soil from selected depths, incubated in water in culture tubes with and without a supplemental energy source, followed by filtration. Both of the methods automatically correct for soil type and pH and are useful in estimating whether the soil zone is deficient in natural energy, reducing potential by bacteria, or amorphous iron. The tests are also helpful in estimating whether Fe(II) may be flowing into area from surrounding areas or escarpments. Measurement of soil solution samples used in conjunction with the laboratory incubation of soil samples yielded the most information suitable for estimating the potential for ochre clogging. The types of soil showing the most potential for ochre formation were fine sands and silty sands, organic soils and organic pans, mixed profiles containing organic matter, gullies, flood plains, and depressions containing organic residues. (Carroll-FRC)
W83-03975

SEDIMENT AND CHANNEL-GEOMETRY INVESTIGATIONS FOR THE KANSAS RIVER BANK-STABILIZATION STUDY, KANSAS, NEBRASKA, AND COLORADO,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2J.
W83-04008

EARLY DEVELOPMENTS IN DRAINAGE ENGINEERING,
Guelph Univ. (Ontario). School of Engineering.
R. W. Irwin.
Agricultural Engineering, Vol 63, No 11, p 16-17, November, 1982. 1 Fig.

Descriptors: *Drainage engineering, *Tile drainage, *Trenches, History, Ontario, Costs, Plastic pipes.

In Ontario in 1907 most tile drains were laid by pick and shovel at the rate of 3 rods per day per person and 15 cents per rod. Horse drawn plows increased the digging rate by 50%. A wheel-type trenching machine was first produced in 1892 and was dominant until 1956. A steam-powered wood frame traction ditcher was available in Canada by 1904 and a steel frame one by 1907. These machines could dig about 100 rods per day at the cost of 7 cents per rod. Drain tiles were 2.5 and 3 inches in diameter prior to 1915 and 4 inches thereafter. Plastic drainage tubing was introduced in Ontario in 1967. In the hand digging days grade control was accomplished by water or an overhead line with gage stick. The trenching machine had a fixed sight arm. Laser grade control was introduced in Ontario in 1970. (Cassar-FRC)
W83-04135

4B. Groundwater Management

GROUND WATER PUMPING FROM SHALLOW AXISYMMETRIC PONDS,
Georgia Inst. of Tech., Atlanta. Dept. of Civil Engineering.
M. M. Aral, and T. W. Sturm.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY12, p 1469-1485, December, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Well hydraulics, *Ponds, *Pumping, Hydraulics, Shallow wells, *Georgia, Coastal plains, Unconfined aquifers, Seepage, Design criteria, Model studies, Aquifer management, Groundwater management.

An examination of the hydraulic aspects of pumping from axisymmetric ponds or large diameter wells in shallow, unconfined aquifers showed that pond storage allows groundwater pumping at higher rates during short time periods than would be possible for continuous pumping. This technique has been proposed for developing the shallow aquifers on the Georgia coastal plain to relieve overpumping of the artesian aquifer. A finite element model was developed. It considered the effects of pond storage, partial penetration, pond size, and pumping time. Application to a typical design problem showed that the total daily volume pumped increased slightly with pumping time, but both pond diameter and pumping rate became smaller as pumping time increased. The storage produced by large ponds allowed much higher pumping rates for short time periods than would be indicated by estimates of steady-state seepage rates. (Cassar-FRC)
W83-03863

FORMATION OF TRANSITION ZONE IN A BASAL AQUIFER UNDER PUMPING STRESSES,
Hawaii Univ., Honolulu. Water Resources Research Center.
S. -O. Chung, L. S. Lau, C. C. K. Liu, and H. K. Gee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265058, Price codes: A03 in paper copy, A01 in microfiche. Technical Memorandum Report No 66, August 1982. 21 p, 12 Fig, 2 Tab, 8 Ref. OWRT A-092-HI(1), 14-34-0001-2113.

Descriptors: *Aquifer characteristics, *Transition zones, *Saline water-freshwater interfaces, Experimental data, *Hawaii, Pumping, *Sand-box model.

Formation of a freshwater-sea water transition zone in a basal aquifer under pumping stresses was studied by sand-box experiments and by comparing experimental data with results from other theoretical and field investigations. Upconing height for different pumping rates and well penetration depths were measured in the laboratory. These experimental data were then compared with theoretical values computed with or without the sharp interface assumption. Dispersivity of laboratory sand was determined by matching the observed thickness of the transition zone with the theoretical value. The thickness of the transition zone was found to increase as the pumping rate and/or the partial well penetration depth increased. The results of the laboratory experiments were compatible with the values predicted by theoretical equations.
W83-03998

CLARIFYING GEOTHERMAL FLUIDS,
Envirotech Corp., Salt Lake City, UT. Eimco Process Machinery Div.
For primary bibliographic entry see Field 5F.
W83-04052

GROUNDWATER POLLUTION: A THREAT TO PUBLIC WATER SUPPLY. (GRUNDWASSERVERUNREINIGUNGEN - BEDROHUNG FUR DIE OFFENTLICHE WASSERVERSORGUNG.),
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
For primary bibliographic entry see Field 5G.
W83-04090

4C. Effects On Water Of Man's Non-Water Activities

COMPARISON OF THE SOIL WATER CYCLE IN CLEAR-CUT AND FORESTED SITES,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
R. G. Kachanoski, and E. De Jong.
Journal of Environmental Quality, Vol 11, No 3, p 545-549, 1982. 1 Fig, 5 Tab, 23 Ref.

Descriptors: *Forest management, *Subsurface drainage, *Logging, Forest watersheds, Forest hydrology, Watershed management, *Clear-cutting, Streamflow, Drainage, *Saskatchewan, Snowmelt, Surface runoff, Runoff.

The importance of subsurface flow and drainage and the effects of clear-cutting on the hydrological cycle were studied in a northern Saskatchewan forested basin October 1978 to October 1979. Surface runoff was measured with interceptor troughs and tipping bucket gages; soil water contents with a neutron probe; soil water fluxes from Darcy's law and mass balance equations; and creek flow with a water level recorder and still well. Surface runoff was negligible (0.1 cm) during the growing season on both forested and clear-cut tracts. However, during the snowmelt period surface runoff was 6.1 cm from the cut plots and zero from the forested plots. Drainage during the growing season was 9.3-13.0 cm from the cut plots and 6.4 cm from the forested plots. Stream hydrographs indicated that this basin was dominated by subsurface flow. On the average about 20% of the precipitation from major storms entered subsurface storage. The increased water yield from the clear-cut plots during snowmelt, occurring almost entirely as surface runoff, would result in higher spring peak flows and shorter lag. (Cassar-FRC)
W83-03894

RECOVERY AFTER LOGGING IN STREAMS WITH AND WITHOUT BUFFERSTRIPS IN NORTHERN CALIFORNIA,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
D. C. Erman, and D. Mahoney.
Water Resources Center Contribtion 186, University of Calif., Davis, June 1983. 39 p, 7 Fig, 11 Tab, 80 Ref, 5 Append.

Descriptors: *Forest management, *Revegetation, *Reforestation, *Clear-cutting, *Aquatic life, *Biomass, Stream biota, Lumber, Vegetation establishment, Sediment transport, Animal populations, Aquatic environment, Aquatic animals, Aquatic plants, Aquatic habitats, Stream degradation.

The impact of logging on aquatic resources involves a reduction in nearstream vegetation and disturbance of the land surface. This frequently leads to elevated sediment loads, increased water temperature, disruption of aquatic food webs, and decreased habitat diverstiy. In some cases logging has resulted in greater diversity and biomass of young salmonids. Six logged sites, six narrow-buffered sites, and 17 controlled sites were sampled from 25 streams grouped into nine blocks in northern California. The samples were taken 6-10 years after logging and 5 or 6 years after an initial postlogging study in order to evaluate recovery rates. Unbuffered streams showed considerable but incomplete recovery based on a diversity index of macroinvertebrates. Compared to the mean of control streams, the mean diversity of logged streams was 9.1% lower in 1980-81 versus 25.2% lower in 1975. Narrow-buffered streams, by contrast, changed little since the last survey. The mean diversity was 12.5% lower than controls in 1980, compared to 12.4% in 1975. The six streams showed a positive association between buffer width and diversity index. By employing a measure of transportable sediment stored in the stream bed, it was found that the logged and narrow-buffered streams still contained significantly more fine sediment than comparable control streams. Narrow buffers were not effective in promoting a more complete or rapid rate of recovery than streams without buffers. A few taxa had higher density in stations with more fine sediment, and, as a result, the diversity index was lower in those stations. (Garrison-Omniplan)
W83-03990

4D. Watershed Protection

COMPUTER AID FOR TERRACE LOCATION,
John Deere Product Engineering Center, Waterloo, IA.
K. A. Sudduth, and J. M. Gregory.
Transactions of the ASAE, Vol. 25, No. 6, p 1622-1627, November/December, 1982. 9 fig, 9 ref.

Descriptors: *Computer programs, *Erosion control, *Terracing, Contour terracing, Soil erosion, Topography, Mathematical studies.

Although farmers are exhibiting a renewed interest in terracing for erosion control, the efficient systems which farmers want often require considerable design effort. Terrace design aids using a computer which have been developed generally depend on prior placement of the terraces before calculations can be performed and require considerable time and labor for data entry. This paper reports the development of a computer program designed to locate terraces based on field topography read from a contour map. The program locates the following alternative terrace systems for a field: a conventional, or constant-grade, system with the grade specified by the user; a smoothed conventional system; and parallel terrace systems, with the terrace spacing as a multiple of machinery width. Terrace systems can be designed with multiple outlets or branched outlets. Usability of the program as a design aid is greatly enhanced by the computerized data entry system, which allows the input of data directly from the topographic map of the field. The program is generally applicable to all types of topography. In developing the program, several unique numerical techniques were developed to manipulate parametric piecewise-cubic spline functions, including algorithms to find the intersections of the functions and to smooth areas of excessive local curvature in the functions. Testing of the terrace location program with both artificial and actual data sets showed that the system worked well in most cases. (Carroll-FRC)
W83-03957

INVESTIGATIONS OF VEGETATION FOR STABILIZING ERODING STREAMBANKS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
A. J. Bowie.
Transactions of the ASAE, Vol 25, No 6, p 1601-1606, 1611, November/December, 1982. 10 Fig, 1 Tab, 10 Ref.

Descriptors: *Erosion control, *Stream banks, *Vegetation establishment, Stream erosion, Bank stabilization, Bank protection, Channel erosion, Scour, *Mississippi.

The use of combinations of vegetation, bank shaping, and structural materials to control erosion of channel banks is being tested on channels in northern Mississippi in order to develop an alternative to the exclusive use of structural materials, which is often prohibitively expensive. Factors considered in designing the combined vegetation and structural bank protection are presented, along with a detailed description of the study sites. Although a complete evaluaton will require several years, some observations made at the end of the second growing season are presented. Checking or elimination of scouring forces creating channel bed degradation is necessary before satisfactory results can be expected from the use of vegetation to stabilize or control bank erosion. the general survival and growth of the grassy and woody species of vegetation planted has been good, in spite of severe hydrologic and plant growth stresses during the period of the studies. Preliminary results indicate that native species of both the grasses and the woody species are preferable to imported varieties. The need for periodic on-site appraisal of channel conditions and for an effective maintenance program to prolong the useful life of stabilization measures and to safeguard the banks against possible erosion in the future is stressed. (Carroll-FRC)
W83-03960

SIMULATION OF SOIL EROSION FROM WINTER RUNOFF IN THE PALOUSE PRAIRIE,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W83-03973

RUNOFF AND SOIL LOSS IN TRINIDAD UNDER DIFFERENT CROPS AND SOIL MANAGEMENT,
University of the West Indies, St. Augustine (Trinidad and Tobago). Dept. of Soil Science.
F. A. Gumbs, and J. I. Lindsay.
Soil Science Society of America Journal, Vol 46, No 6, p 1264-1266, November/December, 1982. 4 Tab, 11 Ref.

Descriptors: *Runoff, *Erosion control, Rainfall-runoff relationships, Erosion, Tillage, Crops, Cowpea, Maize, Corn, *Trinidad.

The immediate objective of this study was to measure the erosion caused by different agricultural practices so that recommendations for reducing soil loss could be made. The longer term objective was to measure soil loss under different conditions and eventually to test the applicability of existing erosion equations, or to modify these for use, under Trinidad conditions. The soil on which the studies were conducted was classified as an isohyperthermic, clayey, oxidic Orthoxic Tropudult. Internal drainage was moderate to good. The soil was partly eroded. Total rainfall for each of the three periods studied was 38.8, 22.4, and 82.5 cm, respectively. At the lower levels of rainfall there was generally a significant increase in soil loss from the bare plots with an increase in slope from 11 to 22 to 52%. A nonsignificant increase in both runoff and soil loss from the cropped plots was also noted. At higher rainfall levels there were significant increases in soil loss from the bare plot and both of the cropped plots with an increase in slope from 11 to 22% only. The effect of tillage of the 22% slope on runoff and soil loss seems to have depended on the level and distribution of the rainfall and on the crop type. At low rainfall, no-tillage does not significantly affect runoff or soil loss, but it significantly reduced soil loss from bare plots if there were intense storms. At highest rainfall level, no-tillage still resulted in high soil losses, and maize and cowpea were less effective than at lower rainfall in reducing soil loss. Soil should not be exposed in the wet season, and the clean cultivation of maize and cowpea in the wet season should not be recommended for slopes greater than 11%. (Baker-FRC)
W83-04028

IMPACT OF EROSION CONTROL POLICIES ON WILDLIFE HABITAT ON PRIVATE LANDS,
Iowa State Univ., Ames. Dept. of Economics.
J. A. Miranowski, and R. L. Bender.
Journal of Soil and Water Conservation, Vol 37, No 5, p 288-291, September/October, 1982. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Soil erosion, *Erosion control, Regulations, Conservation, Water quality, Model studies, River basins, Farming, *Wildlife, Habitats, Environmental impacts, Iowa River basin, *Iowa.

Erosion control policies designed to maintain soil productivity and improve water quality tend to enhance upland wildlife habitat quality with varying degrees of effectiveness. Habitat indexing and valuation procedures are considered in conjunction with a linear programming model of the Iowa River Basin to illustrate these effects. The primary objective of the study was to measure and evaluate the effects of soil erosion control policies, through adjustments in cropping and tillage practices, on wildlife habitat quality. It was concluded that policy designed to reduce soil erosion tends to improve upland habitat quality as well as improve or protect water quality. Some policies are more effective than others in improving habitat. Policies that encourage changes in land use may have a more profound effect on habitat quality than do changes in tillage systems. (Baker-FRC)
W83-04197

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

CHLOROPHENOLS IN RIVER SEDIMENT IN THE NETHERLANDS,
Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands). Unit for Residue Analysis.
R. C. C. Wegman, and H. H. van den Broek.
Water Research, Vol 17, No 2, p 227-230, February, 1983. 3 Fig, 2 Tab, 4 Ref.

Descriptors: *Chlorine, *Phenols, *Rivers, Bottom sediments, Gas chromatography, Pollutants, *Chlorophenols, Chemical analysis, *The Netherlands, Ketelmeer, Rhine River, *Pollutant identification.

Chlorophenols formed when wastewater containing phenolic compounds is treated by chlorination to disinfect the effluent prior to discharge into the surface water possess both odor and taste-spoiling properties. Water and sediment samples from the Rhine River and from several other surface waters throughout The Netherlands were screened for the presence of individual chlorophenols. An analytical method has been developed which used capillary gas chromatography for the determination, after derivatization, of 19 individual chlorophenols in river sediments. Using this methodology, the mimimum detectable limits are 10 micrograms per kilogram for monochlorophenols, 0.5 micrograms per kilogram for dichlorophenols, 0.2 micrograms per kilogram for trichlorophenols, and 0.1 micrograms per kilogram for tetra- and pentachlorophenols. The monitoring program showed that 2,5-dichlorophenol, 2,3,5- and 2,4,5-trichlorophenol, 2,3,4,5- and 2,3,4,6-tetrachlorophenol, and pentachlorophenol were found in all sediment samples taken from Lake Ketelmeer, which is a deposition area for Rhine River sediment. 2- and 4-Monochlorophenol and 2,3,6-trichlorophenol were never found above the detection limit. Sediment samples from the harbor and river sediment dump in the North Sea and from the Spui River contained almost no chlorophenols. The highest concentrations of chlorophenols were found in sediment samples from th Nieuwe Maas River and the Scheur River, which are located in highly industrialized areas. The chlorophenols found in the highest concentrations were 3,4- and 3,5-dichlorophenol. (Carroll-FRC)
W83-03933

EVALUATION OF CORRELATIONS BETWEEN ABSORBANCE AT 254 NM AND COD OF RIVER WATERS,
Vyzkumny Ustav Vodohospodarsky, Ostrava (Czechoslovakia).
M. Mrkva.
Water Research, Vol 17, No 2, p 231-235, February, 1983. 3 Fig, 22 Ref.

Descriptors: *Chemical oxygen demand, *Optical properties, *Pollutant identification, Rivers, Dissolved solids, Organic matter, Water quality, Water analysis, Turbidity, Measuring instruments, *Czechoslovakia.

The possibilities of continuous determinations of organic carbon and chemical oxygen demand (COD) by the permanganate or dichromate method have been investigated over a period of several years. In Czechoslovakia, an ultraviolet analyzer for absorbance measurements at 254 nanometers with automatic turbidity compensation was developed, and its performance was tested in the analysis of drinking water, surface water, and treated wastewaters in laboratories and in full-scale operation. Long-term investigations resulted in the determination of empirical conversion factors for the conversion of absorbance to COD by the permanganate and dichromate methods for various types of water. This study evaluated the correlation between the absorbance methods for various types of water. This study evaluated the correlation between the absorbance module at 254 nanometers and COD by the permanganate and dichromate methods in rivers in the lower part of the Odra River basin having varying degrees of organic pollution. A clean reach of river and two short reaches with medium and high pollution (especially contamination with lignin and humic substances and phenolic wastes below industrial waste outfalls) were evaluated. Results from studies conducted between 1973 and 1978 were evaluated statistically. Close relationships were found between absorbance and COD, and the absorbance

module at 254 nanometers is recommended for use as an indicator of organic pollution in selected reaches of the river. This method is suitable for laboratory work as well as for automatic monitoring of concentration changes in dissolved organic matter. (Carroll-FRC)
W83-03934

THE EFFECT OF VARIATIONS IN ANALYTICAL METHODS ON TRADE EFFLUENT CHARGES,
Southern Water Authority, St. Leonards (England). East Sussex Water and Drainage Div.
D. Ballinger, A. Jamison, S. Kemsley, A. Lloyd, and A. Morrish.
Water Pollution Control, Vol 81, No 5, p 665-673, 1982. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Chemical oxygen demand, *Suspended solids, *Effluent charges, Pollutant identification, Organic matter, Chemical analysis, Quality control, Industrial wastewater, Filtration, Hydrogen ion concentration.

Six variations of the modified Mogden Formula for determining COD in trade effluents were compared. pH significantly affected filtrability and settleability. The methods in which pH was adjusted to 7.0 + or - 0.05 produced up to 41% higher suspended solids results (and lower COD results) than methods not adjusting pH. The sealed tube and standard reflux methods of BOD determination were generally comparable except in wastes with substances incompletely oxidized by acid dichromate or high levels of chloride, detergents, or volatile water soluble solvents. (Cassar-FRC)
W83-03938

SOLUBLE REACTIVE PHOSPHORUS MEASUREMENTS IN LAKE WATER: EVIDENCE FOR MOLYBDATE-ENHANCED HYDROLYSIS,
S. J. Tarapchak.
Journal of Environmental Quality, Vol 12, No 1, p 105-108, January-March, 1983. 1 Fig, 1 Tab, 26 Ref.

Descriptors: *Phosphates, *Water analysis, *Molybdenum blue method, Pollutant identification, Organic compounds, Hydrolysis, Natural waters, *Lake Michigan.

The effects of Mo on phosphate estimation were investigated in filtered Lake Michigan water samples. Phosphate was measured by the Chamberlain-Shapiro extraction method after several pretreatments: acid addition, simultaneous addition of Mo and acid, or Mo addition. Phosphate values were higher for Mo addition alone. Mo addition accelerates hydrolysis in the presence of acid and either causes hydrolysis or forms organic-phosphate-Mo before samples are acidified. A major fraction of the blue color formed during analysis by the Mo blue method and its variation is apparently not the product of acid hydrolysis but may be due to reduction of organic-phosphate-Mo. (Cassar-FRC)
W83-03977

NITRATE IN NEVADA PLAYAS,
Nevada Univ. System, Reno. Desert Research Inst.
S. Leatham, L. N. Huckins, and R. L. Jacobson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265025, Price codes: A07 in paper copy, A01 in microfiche. Publication No 41086, August 1983. 128 p, 18 Fig, 11 Tab, 47 Ref, 5 Append. OWRT A-093-NEV(1), 14-34-0001-0130.

Descriptors: *Nitrates, *Nitrogen fixing bacteria, *Playas, Soil profiles, Nitrogen cycle, Nitrogen fixation, *Nevada, Great Basin Playas, *Playa sediments, Hydrogen ion concentration, Volcanic rock, Microoganisms, Cyanophyta.

Nitrate accumulations on Great Basin playas appear to depend on three factors. The factors are: 1) pH of the playa sediment; 2) amount of volcanic rocks surrounding the playa; and 3) types of microorganisms and their nitrogen-fixing capabilities. All playa samples with N0 sub 3 concentrations <1000 mg/Kg have pH values of approximately 9 or greater. Again with one exception all the samples with N0 sub 3 values >1000 mg/kg are located in basins primarily surrounded by volcanic and igneous rocks. The playas in the southern part of the Great Basin appear to have higher N0 sub 3 values perhaps due to a climate that may permit greater amounts of nitrogen fixation. Unusually high nitrate concentrations were found in soils of Yucca and Frenchman Flats. A maximum concentration of 11,100 mg/kg was found within the 2-6 inch soil depth on Frenchman playa. Maximum nitrate concentrations in the playa soils generally occurred within the 6 inch to 2 foot soil depth. The maxima for all playa sampling sites averaged 4,693 mg/kg nitrate. Soils from the bajada had lower nitrate concentrations, with an average maximum concentration of 588 mg/kg. Nitrogen fixation by blue-green algae was found to occur at 79% of the randomly chosen sample sites. Under optimum laboratory conditions nitrogen fixation ranged from 4.1 to 46,100g N sub 2/acre/day. Average nitrogen fixation in soil cores was 359g N sub 2/acre/day whereas, the average fixation by algal crusts was 5,527g N sub 2/acre/day. Where nitrate was found to accumulate there was generally an associated decrease in the pH of the soil (from about 9.0 to 7.0) possibly indicating the oxidation of atmospheric nitrogen fixed by algae to nitrate by Nitrosomonas and Nitrobacter.
W83-03994

CLOSTRIDIUM PERFRINGENS AS AN INDICATOR OF STREAM WATER QUALITY,
Hawaii Univ., Honolulu. Water Resources Research Center.
R. S. Fujioka, and L. Shizumura.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265066, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 154, June 1983. 37 p, 3 Fig, 12 Tab, 16 Ref. OWRT A-087-HI(1), 14-34-0001-1113.

Descriptors: *Bacteria, *Clostridium perfringens, Water quality, Water pollution, Streams, Effluent, Indicators, *Bioindicators, *Fecal coliform, *Fecal streptococcus, Kipapa stream, Ahuimanu stream, Oahu, *Hawaii.

The mCP medium devised by Bisson and Cabelli in 1979 was used to recover Clostridium perfringens from sewage and streams. This membrane filtration method proved to be uncomplicated and reliable. Of 98 presumptively positive colonies recovered from various stream samples, 89 or 91% were confirmed as C. perfringens by using biochemical tests, whereas only 1 of 29 (3%) of the presumptively negative colonies was subsequently confirmed as C. perfringens. The quality of streams receiving treated and chlorinated sewage effluent was determined by analyzing the effluent entering the stream as well as stream samples and below the effluent discharge site for fecal coliform (FC), fecal streptococcus (FS), and C. perfringens (CP). Chlorination was shown to drastically reduce the concentrations of FC and FS, but not CP in the sewage effluent. As a result, the concentrations of FC and FS in the chlorinated effluent were less than the natural concentrations of these bacteria in the stream, whereas the same effluent contributed significantly more CP than was naturally present in the stream. Thus, analysis of stream water for CP, but not FC or FS, clearly indicated the input of effluent into the stream. Moreover, the FC:CP ratio was useful in determining the quality and distance of a major source of pollution within a stream.
W83-03999

METAL BINDING STUDIES OF ORGANIC MATERIALS IN WATER SYSTEMS,
North Dakota Univ., Grand Forks. Dept. of Chemistry.
D. E. Bartak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265108, Price codes: A06 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State Univ., Fargo, August 1983. 101 p, 4 Tab, 21 Fig, 76 Ref. OWRT A-077-NDAK(1), 14-34-0001-2136.

Descriptors: *Speciation, *Chromatography, Infiltration, Copper, Phenols, Fulvic acids, Humic acids, Aquatic environment, Chemical reactions, *Pollutant identification, *Trace metals, Electrochemistry, Metal complexes, Water sampling.

The chemical speciation of trace metals in aquatic environments play a key role in their transport, chemical reactions, and biological availability. The nature and concentration of a given trace metal in solution is most important in determining its speciation. This research developed a technique for the quantitation of metal complexes in natural water samples. Using modified size-exclusion chromatography and reversed-phase ion-pair chromatography, metal complexes were separated and detected using an electrochemical flow-cell detector. A reverse pulse amperometry mode is used to minimize oxygen interferences in the flow system. Optimum conditions for the chromatographic columns, which utilized a copper(II) eluant at pH=7.4, including gel particle size, eluate flow rate and concentration of applied sample were determined using a series of polyaminocarboxylic acids. The equilibrium M+L ML is established quickly and is maintained by constant metal ion concentration made to the eluent. This prevents the dissociation of labile complexes. Polyaminocarboxylic acids used in developing the technique were DTPA, EDTA, and NTA. Size-exclusion chromatograms of a series of amino acids, carboxylic acids and phenols were studied in developing the technique. Polyaminocarboxylic acids and natural water ligands were tested on the reversed-phase ion-pair column in preliminary studies to establish its utility for the separation of metal complexes. Detection limits for EDTA which had been separated on all three chromatographic systems were calculated.
W83-04003

ASSESSMENT OF HYDROLOGIC CONDITIONS IN POTENTIAL COAL-LEASE TRACTS IN THE WARRIOR COAL FIELD, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2A.
W83-04010

A STATISTICAL ANALYSIS OF THE QUALITY OF SURFACE WATER IN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-04014

DIRECT DETERMINATION OF ALUMINIUM IN NATURAL WATERS BY LASER STEPWISE PHOTOIONIZATION,
Akademiya Nauk SSSR, Moscow. Inst. Spektroskopii.
G. I. Bekov, A. S. Yegorov, V. S. Letokhov, and V. N. Radayev.
Nature (London), Vol 301, No 5899, p 410-412, February 3, 1983. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Water analysis, *Aluminum, *Measuring instruments, Lasers, Photoinionization, *Photoionization, Chemical analysis, *Pollutant identification.

A new highly sensitive analytical method for the analysis of microelements and aluminum, particularly in natural waters, is presented which is based on a technique involving thermal atomization of the sample under vacuum and detection of the element atoms through their stepwise excitation to a Rydberg state and subsequent ionization by electric field pulse. Aluminum was determined in natural waters as follows. A water sample was introduced into a tantalum crucible and evaporated at 90 degrees C to obtain a dry residue. The crucible and its contents were placed in a vacuum chamber. The evaporating atoms and molecules of the sample were formed into an atomic-molecular beam using diaphragms. The beam was irradiated between two electrodes by two tunable dye lasers pumped simultaneously with a nitrogen laser. The wavelengths of the dye lasers were tuned for two step excitation of aluminum atoms to a Rydberg state. After laser excitation an electric pulse that

ionized all the Rydberg atoms was fed to the electrodes. The resulting ions were pushed by the same electric field pulse through a hole in one of the electrodes, then they were detected by an electron multiplier. The ion signal from the electron multiplier was passed to a boxcar averager and was registered by a recorder. This method has been used to measure dissolved aluminum in samples taken in the mouth of the Kura River at the Caspian Sea (Baker-FRC)
W83-04016

A PROPOSED ROUTINE METHOD FOR DETERMINING POLYCYCLIC AROMATIC HYDROCARBONS (VORSCHLAG FUR EINE ROUTINEMETHODE ZUR BESTIMMUNG POLYCYCLISCHER AROMATISCHER KOHLENWASSERSTOFFE),
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
B. Wiemer.
Acta Hydrochimica et Hydrobiologica, Vol 9, No 3, p 337-345, March, 1981. 5 Tab, 50 Ref. (No English Summary).

Descriptors: *Water analysis, *Hydrocarbons, *Thin layer chromatography, *Pollutant identification, *Chemical analysis, Water sampling, Costs, Polycyclic aromatic hydrocarbons, Ultraviolet radiation, Chromatography, Separation techniques, Isolation, Sediments.

It is important to find a reliable and reproducible method for detecting polycyclic aromatic hydrocarbons (PAH) in water because they occur in very low concentrations, together with other organic and inorganic substances. An overview of previously published procedures for the concentration, isolation or separation, and identification of PAH is presented in tabular form. Since costs for gas and liquid chromatography are high and these methods of isolation and identification are not comprehensive, thin-layer chromatography, a relatively simple and inexpensive procedure, is the method of choice. Detailed instructions for the procedure are given, including type of chemicals required and their manufacturers and equipment, for sample taking, chromatography, distillation, and cyclohexane purification. Concentration of a 1,000-ml water sample is done with 60 ml double-distilled cyclohexane, evaporated off to 0.1 ml. The sample is then prepurified on the thin-layer plate with double development of the plate using ultraviolet light and a 1:1 mixture of benzene and cyclohexane for eluion. The 0.25-mm layer is composed of silica gel G, acetylated cellulose, and aluminum oxide G. After two-dimensional development and drying of the layer, the slide is placed under an ultraviolet light (366 nm) and sample spots compared with a standard solution for position and size. Spot areas are transferred diagramatically to paper and are measured planimetrically. Variance analysis showed that this method is suitable for semiquantitive determination of 3,4-benzpyrene, 11,12-benzofluoranthene, indeno-1, 2,3-(cd)pyrene, fluoranthene, and 1,12-benzoperylene. Testing of the concentration procedure revealed that 71.5-120% of the added amount of PAH was recovered. For PAH detection in sediments, only the concentration procedure need be adapted. (Gish-FRC)
W83-04047

THE USE OF GLASS-FIBER PAPER IN WATER ANALYSES. PART 1: PROPERTIES, PREPARATION, RINSING AND SCOURING LOSSES (VERWENDUNG VON GLASFASERPAPIER IN DER WASSER-ANALYTIK. TEIL 1: EIGENSCHAFTEN, VORBEREITUNG, ABSPUL- UND AUSWASCHVERLUSTE).
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.). Aussenstelle Labor Rudolstadt-Schwarza.
P. Loth.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 495-498, May 1980. 2 Tab, 8 Ref. (No English Summary).

Descriptors: *Sample preparation, *Water analysis, *Filters, *Scour, *Performance evaluation, Laboratory equipment, Fiberglass paper filters, Weight, Physical properties, Wash water, Paper filters, Filtration, Detection limits, Seston.

Two types of fiberglass paper were tested for use as filters in water analysis. Type 13-100 weighed 100 g/sq m, was 0.8 mm thick, and had a separation capacity of 99.90%, air resistance of 12 mm H20, a breaking load of 0.75 kg/15 mm, a temperature tolerance of 180C, and atmospheric water absorption of 0.75%. Corresponding figures for type 15-90 were 90 g/sq m, 0.8 mm, 99.95%, 10 mm H20, 0.50 kg/15 mm, 240C, and 0.50%. Two preparation procedures were tested: the simple procedure (s) consisted of centrifugation in distilled water (about 1 min), suction of 200 ml distilled water through the paper, and drying of the filter at 105C, followed by weighing; the full procedure (f) consisted of drying the filter at 105C for 60 min, followed by s. The f procedure resulted in a smaller rinsing and scouring loss for filters with a diameter of 40 mm (3.43 vs 3.94 mg/filter for 15-90, 2.42 vs 3.31 mg/filter for 13-100) because preliminary drying resulted in a loss of mass. Another factor to be considered when choosing which paper to use is the detection threshold, which was calculated as 1.3 mg/l for 15/90 for both procedures and 1.5 and 1.1 mg/l for 13-100 for procedures s and f, respectively. While 13-100 (f) is best, 15-90 (f) could also be used satisfactorily. For practical application (e.g., seston determination), the scouring effect need only be taken into account in water with a low seston content; as long as the seston concentration reaches only 1.3 mg/l, scouring loss remains within the acceptable error range of 20%. The advantages of fiberglass paper are ease of application, adequate weight constancy, and good filtration performance. It is quicker and less expensive to use than membrane filters. (Gish-FRC)
W83-04050

USE OF THE MUSSEL MYTILUS-EDULIS-PLANULATUS (LAMARCK) IN MONITORING HEAVY METAL LEVELS IN SEAWATER,
Tasmania Univ., Hobart (Australia). Dept. of Zoology.
D. A. Ritz, R. Swain, and N. G. Elliott.
Australian Journal of Marine and Freshwater Research, Vol 33, No 3, p 491-506, 1982. 9 Fig, 3 Tab, 25 Ref.

Descriptors: *Heavy metals, *Seawater, *Monitoring, *Bioassays, *Mytilus, Water pollution effects, Cadmium, Copper, Lead, Zinc, Accumulation, Animal tissues, Mussels, Absorption, Bioindicators, *Australia, Tasmania, Pollutant identification.

The accumulation of cadmium (Cd), copper (Cu), lead (Pb) and zinc (Zn) in tissues of the mussel, Mytilus edulis planulatus, was examined in seawater spiked with different metal concentrations. A linear relationship was found for all the metals tested, and, for some metals, even after exposure to the metal for up to 86 days. The relationship between a metal's concentration in seawater and its rate of accumulation in M. e. planulatus over a 40-day period was determined. Field test results showed that the rated of accumulation could be used as a sensitive method for estimating metal concentrations in seawater with less trouble than techniques involving direct analysis. A monitoring program is proposed in which M. e. planulatus may be used to quantify concentrations of heavy metals in seawater. Some biological and physicochemical parameters which may affect the accumulation of heavy metals in M. e. planulatus and limit the usefulness of this mussel as a bioassay organism in monitoring programs are considered. (Geiger-FRC)
W83-04053

CHEMICAL EVOLUTION OF ORGANIC MICROPOLLUTION DURING OZONATION OF FILTERED WATER (EVOLUTION CHIMIQUE DES MATIERES ORGANIQUES AU COURS DE L'OZONATION D'UNE EAU DE SURFACE FILTREE),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5F.
W83-04058

USE OF PARTICLE SIZE ANALYSIS IN DRINKING WATER PREPARATION (ZUM EINSATZ VON PARTIKELGROSSENANALYSEN IN DER TRINKWASSERAUFBEREITUNG),
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
M. R. Jekel.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 11, p 555-560, 1982. 8 Fig, 3 Tab, 14 Ref.

Descriptors: *Water analysis, *Suspended solids, *Particulates, Filtration, Ozonation, Sedimentation, Flocculation.

More detailed information can be gathered through the use of particle concentration and size analysis of waters as a direct method than scattered light measurements or gravimetric determination of suspended matter. A mechanism is described by which measurement of the projection area of suspended particles above one micron can be determined. Data from three treatment plants with different concepts shows the efficiency of rapid filtration, ozone-floc filtration and the combination of preozonation, flocculation with sedimentation and rapid filtration in view of particle numbers, size distributions and volume concentration of solids. A comparison of scattered light measurements in different angles with particle analysis showed a better correlation of the analysis data with the forward scattering light. (Baker-FRC)
W83-04091

IDENTIFICATION AND MUTAGENIC PROPERTIES OF SOME CHLORINATED ALIPHATIC COMPOUNDS IN THE SPENT LIQUOR FROM KRAFT PULP CHLORINATION,
Svenska Traeforskningsinstitutet, Stockholm.
K. P. Kringstad, P. O. Ljungquist, F. de Sousa, and L. M. Stromberg.
Environmental Science and Technology, Vol 15, No 5, p 562-566, May, 1981. 4 Tab, 33 Ref.

Descriptors: *Organic compounds, *Chlorination, *Mutagens, Pulp wastes, Kraft mills, Pollutant identification, Mutagenesis, Toxicity, Gas chromatography, Carcinogens.

Some chlorinated compounds found in spent liquor from bleaching softwood kraft pulp were identified by gas chromatography/mass spectrometry after enrichment by sorption (XAD 4) and ion exchange (DEAE Sepharose). Compounds included chloroform and carbon tetrachloride, both known carcinogens, and 1,3-dichloroacetone and 2-chloropropenal, strong mutagens. Other compounds in the spent liquor were dichloromethane, bromodichloromethane, dibromochloromethane, trichloroethylene, tetrachloroethylene, pentachloropropene, monochlorinated methylbutenes, monobrominated methylbutene, tetrachloroallene, methyl dichloroacetate, ethyl chloroacetate, ethyl dichloroacetate, ethyl trichloroacetate, monochloroacetone, 1,1-dichloroacetone, 1,1,1- and 1,1,3-trichloroacetone, 1,1,1,3- and 1,1,3,3-tetrachloroacetone, penta and hexachloroacetone, trichlorocyclobutenone, cyclopentene-1,1-diones, and monochloro- and trichloroacetaldehyde. (Cassar-FRC)
W83-04094

THE DETERMINATION OF TRACE ELEMENTS IN NATURAL WATERS USING THE STABILIZED TEMPERATURE PLATFORM FURNACE,
Perkin-Elmer Corp., Norwalk, CT.
D. C. Manning, and W. Slavin.
Applied Spectroscopy, Vol 37, No 1, p 1-11, 1983. 16 Fig, 6 Tab, 47 Ref.

Descriptors: *Water analysis, *Trace metals, Aluminum, Beryllium, Arsenic, Cadmium, Cobalt, Chromium, Copper, Manganese, Nickel, Lead, Selenium, Vanadium, Atomic absorption spectroscopy, Spectroscopy.

Methods are presented for the determination of several trace elements in natural waters and effluents. The elements studied included Al, As, Be, C, Co, Cr, Cu, Mn, Ni, Pb, Se, and V. The stabilized temperature platform furnace was used

with suitable matrix modifiers. Confirmation of the technique was secured by recovery experiments at four different concentration levels. Only simple aqueous standards were required, and the method of additions was not used. A simple recovery experiment gave satisfactory confirmation of freedom from chemical interference. The detection limits in natural waters were less than 1 microgram/liter, closer to 0.1 microgram/liter for most of the elements. Precision was 10-15%. Cleanroom facilities are not required for this method. (Baker-FRC)
W83-04118

A RESONANCE RAMAN METHOD FOR THE RAPID DETECTION AND IDENTIFICATION OF ALGAE IN WATER,
Rhode Island Univ., Kingston. Dept. of Chemistry.
S. K. Brahma, P. E. Hargraves, W. F. Howard, Jr., and W. H. Nelson.
Applied Spectroscopy, Vol 37, No 1, p 55-58, 1983. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Water analysis, *Algae, *Remote sensing, *Spectroscopy, Raman spectroscopy, Light scattering, Water quality.

Because of the high sensitivity of the resonance Raman method for detecting carotenoids and chlorophylls, most algae should exhibit strong spectra in vitro, despite the pigments accounting for only a small fraction of the cellular biomass. Attempts were made to determine the reproducibility of spectra of several species in vitro; whether spectra are sufficiently unique for identification at different taxonomic levels; the variability of spectra at different growth stages; and the rapidity of data collection. Spectra taken at 488 or 457.9 nm are of high quality and are sufficiently distinct to differentiate clones at the algal class level, and possibly also at the genus level. Strongest peaks occur near 1527 and 1158/cm. However, information is contained in the entire region between 900 and 3000/cm due to associated overtone and combination bands which can be assigned along with fundamental vibrations. Chlorophyll peaks are also quite pronounced. Spectra obtained using rapid flow techniques match those taken using slurries in sealed tubes if low laser power is used. The sensitivity and rapidity of the techniques suggest that it may be useful in remote sensing applications. (Baker-FRC)
W83-04119

DIRECT DETERMINATION OF TRACE AND SUBTRACE METALS IN NATURAL WATERS BY DPASV. THE USE OF LONG-LASTING SESSILE-DROP MERCURY ELECTRODES COMPARED TO COMMERCIAL HANGING-DROP MERCURY ELECTRODES (KEMULA TYPE),
Rome Univ. (Italy). Ist. de Chimica.
R. Andruzzi, A. Trazza, and G. Marrosu.
Analytical Letters, Vol 15, No 19, p 1565-1584, 1982. 7 Fig, 1 Tab, 9 Ref.

Descriptors: *Trace metals, *Electrodes, *Metals, Pollutant identification, Cadmium, Water analysis, Voltammetry, Mercury electrodes.

The performance of a new semi-stationary mercury electrode was compared with two commercially available Kemula hanging mercury drop electrodes (HMDE) for direct determination of trace and subtrace levels of metals in water and seawater using differential pulse anodic stripping voltammetry. The long-lasting sessile-drop mercury electrode (LLSDME) produced relative standard deviations of 1.3-5.3% in an analysis of Cd (19.3-57.7 ng per liter) added to a sodium chloride solution. Standard deviations for a metrohm HMDE electrode were 6.0-12.2%. In addition the Cd peak of the LLSDME was more defined. The LLSDME was also much more sensitive to Cd in seawater than a silicone-coated HMDE, which must be used in the presence of natural surface active substances. The silicone-coated HMDE was not suitable for determination of Cd concentrations below 40 ng per liter. (Cassar-FRC)
W83-04122

DETERMINATION OF MERCURY IN WATER BY FURNACE ATOMIC ABSORPTION SPECTROMETRY AFTER REDUCTION AND AERATION,
Exxon Nuclear Idaho Co., Inc., Idaho Falls.
D. D. Siemer, and L. Hageman.
Analytical Chemistry, Vol 52, No 1, p 105-108, January, 1980. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Water analysis, *Mercury, Heavy metals, Chemical analysis, Spectral analysis, Sample preparation.

In order to combine the excellent absolute sensitivity of graphite furnace atomic absorption with the large sample volume capability of the Hatch and Ott process for mercury determination in aqueous solutions at low concentrations, the gold-plated, porous graphite atomizer tube mercury filtration system previously applied to air and solids analysis was adapted to water analysis. The technique should also free the overall analytical response from any sensitivity to variations in experimental conditions which affect only the rate at which a given mass of mercury is sparged from the sample solution. Mercury present in the water samples was reduced to the metal in a bubbler and sparged from the solution with a stream of air. The gas stream was then filtered through porous, gold-plated graphite furnace atomizer tubes which retained the mercury. The tubes were then placed into either a carbon rod atomizer or a Woodriff furnace for the actual atomic absorption mercury determination. Each determination takes about 3 minutes. The detection limit was about 10 ppt. The main disadvantages are that there are additional manipulations required to perform an analysis and the fact that the analyst will have to make his own tubes and filter adaptor as they are not commercially available. (Baker-FRC)
W83-04123

AN EVALUATION OF AUTOMATED SPECTRUM MATCHING FOR SURVEY IDENTIFICATION OF WASTEWATER COMPONENTS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Environmental Research Lab., Athens, GA.
W. M. Shackelford, D. M. Cline, L. Faas, and G. Kurth.
Analytica Chimica Acta, Vol 146, p 15-27, 1982. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Pollutant identification, *Wastewater treatment, Chemical analysis, Gas chromatography, Mass spectrometry, Data collections.

An automated system for extracting spectra and matching them against a library of reference spectra was assembled and tested on 20,000 g.c.m.s. data files over a period of 2.5 years. Data used in the study had been collected from a comprehensive study of wastewater from industrial and publicly owned treatment works. The use of an automated spectrum matching system for survey identification proved quite feasible with little intervention. The reliability of matching when an historical library of retention data is used in conjunction with the spectrum library is at least 65%, including matching specific isomers. In this study a 71% overall reliability was achieved when specific isomer resolution was not required. Use of retention data greatly enhances the reliability of lower quality matches, but has little effect on high quality matches. Both positive and negative points of the match must be considered before reliability is assigned. (Baker-FRC)
W83-04124

SINGLE-DROP TENSAMMETRY,
Aarhus Univ. (Denmark). Dept. of Chemistry.
D. Britz.
Analytica Chimica Acta, Vol 115, p 327-330, March, 1980. 4 Fig, 8 Ref.

Descriptors: *Surfactants, *Water analysis, Chemical analysis, Solutions, Tensammetry.

The use of a single-drop sweep technique and a minicomputer or microprocessor is proposed for the determination of surfactant species in solution via tensammetry. In tensammetry the peak height is the usual analytical signal employed. However, a better analytical signal to use in surfactant analysis is the peak potential, which is logarithmically related to concentration over a wide range and will not suffer from iR drop problems. For large surfactant concentrations this peak potential is the recommended analytical signal to be used, but at low concentrations the peak height may be better. Single drop experiments were conducted using an alpha LSI 16-bit minicomputer with 4K of volatile core coupled with a laboratory-built potentiostat. The results achieved demonstrate the utility of single-drop, differential staircase sweep tensammetry. (Baker-FRC)
W83-04125

POTENTIOMETRIC STRIPPING ANALYSIS FOR MERCURY AFTER PRECONCENTRATION IN A POTASSIUM PERMANGANATE TRAP,
Goeteborg Univ. (Sweden). Dept. of Analytical and Marine Chemistry.
D. Jagner, and K. Aren.
Analytica Chimica Acta, Vol 117, p 165-169, June, 1980. 1 Fig, 3 Ref.

Descriptors: *Mercury, *Water analysis, Chemical analysis, Heavy metals, Potentiometry, Chemical interferences.

An acetate buffer containing potassium permanganate and copper(II) was used as a trap solution for mercury prior to potentiometric stripping analysis. A potentiometric stripping curve is presented which was recorded after 16 min of pre-electrolysis in 5 ml of trap solution into which the total mercury content of a 1500-ml water sample had been preconcentrated. The mercury concentration of the water sample was 0.19 micrograms/liter. A calibration plot was obtained by spiking 1500 ml samples of mercury-free double distilled water samples with known amounts of mercury(II). Prior to potentiometric stripping analysis the mercury content of the water sample was pre-constructed into a 5 ml trap solution. The relative accuracy of the method is on the order of 10-5% in the concentration range investigated, 0.02-5 micrograms/liter. Sample contamination and impure reagents were the major factors limiting the accuracy. The detection limit in potentiometric stripping analysis is inversely proportional to the time of pre-electrolysis. The maximum practical pre-electrolysis time is about one hour, which corresponds to a mercury detection limit of 2 micrograms/liter in the trap solution. Since the maximum sample volume is 5 liters, this corresponds to a detection limit in the sample of 0.002 micrograms per liter. This technique can be used as an alternative to atomic absorption spectrometry. Simpler instrumentation is required for potentiometric stripping, and the mercury signal is easily identified by its stripping potential, so that analyses can be done semi-automatically. (Baker-FRC)
W83-04126

DETERMINATION OF TRACE AMOUNTS OF MOLYBDENUM IN NATURAL WATERS BY SOLVENT EXTRACTION-ATOMIC-ABSORPTION SPECTROMETRY, AFTER CHELATING ION-EXCHANGE PRECONCENTRATION,
Seville Univ. (Spain). Dept. of Basic and Applied Chemistry.
M. Ternero, and I. Gracia.
Analyst, Vol 108, No 1284, p 310-315, 1983. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Molybdenum, *Water analysis, *Chelation, Pollutant identification, Trace metals.

A proposed method for determination of molybdenum in natural waters involves preconcentration on a Chelex-100 chelating resin and elution with ammonia solution, followed by extraction with a complexing reagent, 1,4-dihydroxyphthalimide dithiosemicarbazone dissolved in N,N-dimethylformamide/isoamyl alcohol (1:4), with final determination by atomic absorption spectrometry. Adding ascorbic acid solution before extraction eliminated the interferences from vanadium and ferric iron.

Other interfering metallic ions were not retained well on the chelating resin. The sensitivity of the method was 0.3 micrograms per liter for 1% absorption. Mo levels (micrograms per liter) in several natural waters in Spain were 0.3 in bottled water, 0.9 in a public water supply (Seville), 2.7 in Guadalquivir River water, 6.3 in the dock area of the river, 7.5 in Atlantic Ocean water, and 9.9 in estuary water (Huelva). (Cassar-FRC)
W83-04127

SPECTROPHOTOMETRIC DETERMINATION OF PHOSPHATE IN RIVER WATERS WITH MOLYBDATE AND MALACHITE GREEN,
Okayama Univ. (Japan). Dept. of Chemistry.
S. Motomizu, T. Wakimoto, and K. Toei.
Analyst, Vol 108, No 1284, p 361-367, 1983. 6 Fig, 5 Tab, 13 Ref.

Descriptors: *Phosphates, *Water analysis, Pollutant identification, Ammonium molybdate, Malachite green, Spectrophotometry, Trace elements.

Trace amounts (ppb) of phosphate were determined in river water by spectrophotometric measurement at 650 nm of the color formed by ammonium molybdate and malachite green solutions added to the sample after acidification with sulfuric acid and 40 min heating at 90C in a water bath. Polyvinyl alcohol stabilized the color for at least 1 day. The relative standard deviation was <4%; the recovery, 95-101%. Phosphorus concentrations (ppb) in water from three Japanese rivers were: Asahi, 10.6-37.5; Yoshii, 21.9-33.0; and Takahaski, 13.2-30.8. (Cassar-FRC)
W83-04128

SPECTROPHOTOMETRIC AND FLUORIMETRIC DETERMINATION OF BORON IN SOILS, PLANTS AND WATER BY EXTRACTION WITH 2-METHYLPENTANE-2,4-DIOL IN ISOBUTYL METHYL KETONE,
Zaragoza Univ. (Spain). Dept. of Analytical Chemistry.
J. Aznarez, A. Bonilla, and J. C. Vidal.
Analyst, Vol 108, No 1284, p 368-373, 1983. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Boron, *Water analysis, Pollutant identification, Spectrophotometry, Fluorometry.

Two methods for determination of boron were developed. Both began with extraction of boron with 2-methylpentane-2,4-diol in isobutyl methyl ketone (to eliminate iron interference). For the spectrophotometric procedure (reading at 510 nm) the color was developed by adding curcumin solution in glacial acetic acid. For the fluorimetric procedure (reading at 390 or 400 nm) the color was developed by reaction of boron with dibenzoylmethane-isobutyl methyl keton solution and concentrated phosphoric acid. Boron concentrations in soil samples were 78-288 micrograms per g; in plant samples, 15.5-60.1 micrograms per g; and in natural waters from the province of Teruel, Spain, 124-255 micrograms per liter. The spectrophotometric and fluorimetric methods applied to the same samples produced comparable results. (Cassar-FRC)
W83-04129

ANALYSIS OF CHEMISTRY ASSOCIATED WITH OZONOLYSIS OF ORGANIC POLLUTANT MOLECULES IN WATER,
Wesleyan Univ., Middletown, CT.
W. C. Pringle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105394, Price codes: A05 in paper copy, A01 in microfiche. Institute of Water Resources Completion Report, Univ. of Connecticut, Storrs, September 1983. 77 p, 18 Fig, 2 Tab, 30 Ref, 1 Append. OWRT B-017-CONN(2), 14-34-0001-1213.

Descriptors: *Pollutant identification, *Chlorinated hydrocarbons, Ozonation, Spectroscopy, Water analysis, Analytical techniques, Water Chemistry, Fluorescence.

Ozonation of dibenzofuran and several chlorinated hydrocarbons in aqueous solutions and non-participating solvents is reported. The rate constants, activation energy, products and possible reaction mechanisms are determined. The ozonation is three orders of magnitude faster in water than nonaqueous solutions. Spectroscopic techniques for detection of trace pollutants in water are reported. A linear array Reticon detector system capable of detecting weak, energy-resolved fluorescence at high resolution has been built, modified and tested. It has been shown that addition of an image intensifier would result in a detector several orders of magnitude more sensitive than a photomultiplier tube.
W83-04141

DETERMINING RESIDUAL CHLORINE: EFFECT OF TEMPERATURE ON THE TITRAMETRIC STARCH-IODINE END POINT,
Ametek, Inc., Sheboygan, WI. Plymouth Products Div.
G. L. Hatch, and V. Yang.
Journal of the American Water Works Association, Vol 75, No 3, p 154-156, March, 1983. 3 Fig, 24 Ref.

Descriptors: *Temperature effects, Chlorination, *Residue chlorine, *Iodometric titration, *Pollutant identification, *Chlorine, *Volumetric analysis.

The determination of low levels of residual chlorine by the starch-iodine titrimetric method is influenced by temperature. For chlorine concentrations of 0.25-3.0 mg per liter premature starch-iodine end points cause underestimation of 0.25 mg per liter at 30C and 0.70-0.75 mg per liter at 40C. All titrations should be conducted at temperatures below 20C. If analyses in water treatment plants are conducted at warmer temperatures, overchlorination, with greater costs and increased trihalomethane formation, could result. (Cassar-FRC)
W83-04176

DETERMINATION OF TRACES OF COPPER IN TAP WATER, IRON AND STEELS BY ELECTROTHERMAL ZEEMAN ATOMIC ABSORPTION SPECTROMETRY WITH A GRAPHITE CUPPED FURNACE,
Kitami Inst. of Tech., Hokkaido (Japan).
I. Atsuya, K. Ito, and M. Otomo.
Analytica Chimica Acta, Vol 147, p 185-192, 1983. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Copper, Potable water, *Iron, *Steel, *Pollutant identification, *Spectrophotometry, Drinking water, Water analysis, Separation techniques, Trace elements.

The determinations of copper in iron, steels and tap water by electrothermal Zeeman atomic absorption spectrometry with a graphite cupped furnace are described. The procedures are optimized with respect to drying, ashing temperatures, and hydrochloric acid concentration, thus allowing copper to be determined in steel and iron samples without preliminary separation. Use of a graphite cupped type furnace reduces interfering effects originating from small variations in atomization rate. The effects of iron and other elements present in iron and steel on the determination of copper were also examined. Traces of copper in tap water were determined after preconcentration by coprecipitation with lead sulfide, with blank corrections for the acids and water samples used. The present technique provides a simple rapid, sensitive and accurate method of analysis, requiring no preseparation and only a small sample size. (Geiger-FRC)
W83-04189

DETERMINATION OF DEUTERIUM OXIDE IN WATER BY REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Toyohashi Univ. of Technology (Japan). School of Materials Science.
K. Jinno.
Analytica Chimica Acta, Vol 147, p 393-395, 1983. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Deuterium, *Pollutant identification, High performance liquid chromatography, Water analysis, Heavy water, *Chromatography, Hydrogen.

The determination of deuterium oxide in admixture with water by reversed-phase high-performance liquid chromatography (HPLC) is described. A Trirotar III connected with an SE-11 refractive index detector served as liquid chromatography, and the stainless steel tube column was packed with Jasco Finesil C18. A heavy test water served as sample, and acetonitrile and double-distilled water were used as mobile phase. Detection limits were < 0.1% deuterium oxide in a sample size of only a few microliters. The whole analysis may be performed in less than 4 minutes. (Geiger-FRC)
W83-04190

POTENTIOMETRIC STRIPPING WITH MATRIX EXCHANGE TECHNIQUES IN FLOW INJECTION ANALYSIS OF HEAVY METALS IN GROUND-WATER,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
A. Hu, R. E. Dessy, and A. Graneli.
Analytical Chemistry, Vol 55, No 2, p 320-328, 1983. 14 Fig, 1 Tab, 21 Ref.

Descriptors: *Water analysis, *Groundwater, Metals, *Heavy metals, Copper, Lead, Cadmium, Bismuth, Tin, Water quality, Groundwater contamination, Potentiometry, *Pollutant identification.

The application of flow injection analysis techniques to the electrochemical determination of metals in water samples by means of an automated, computerized system is considered. The advantages of flow injection analysis (FIA) as a transport system and potentiometric stripping analysis (PSA) as an analytical technique are combined to enhance sample throughput and selectivity for trace metal determination in natural water. The theory behind the method is developed, and the hardware, software, and instrumentation required are presented. Application to real groundwater samples provides a comparison with previously described techniques. The separation of nearby oxidation peaks in potentiometric stripping analysis can be effected by matrix exchange techniques which involve plating in one environment and stripping in another. Flow injection analysis provides a convenient mechanism to automate this process. Heavy metals commonly found in groundwater, such as lead, cadmium, copper, bismuth, and tin, were studied by this technique to explore the scope limits of the method. (Baker-FRC)
W83-04191

CONTINUOUS FLOW DETERMINATION OF FREE CHLORINE IN WATER,
Osaka Prefectural Univ., Sakai (Japan). Lab. of Environmental Chemistry.
T. Aoki, and M. Munemori.
Analytical Chemistry, Vol 55, No 2, p 209-215, 1983. 8 Fig, 2 Tab, 22 Ref.

Descriptors: *Water analysis, *Chlorine, Continuous flow, Water quality, Chemical analysis, Drinking water, Potable water, Quality control, *Pollutant identification.

The continuous determination method is presented for free chlorine, using separation of the molecular chlorine by microporous PTFE tubing and UV absorption of OCl(-) at 290 nm. Molecular chlorine, produced by mixing a sample with 1 N HCl in the outer tube, permeates microporous PTFE and dissolves in 0.1 N NaOH in the inner tube, changing it to C10(-). The inner solution flows into a UV detector, and C10(-) is measured spectrophotometrically at 290 nm. UV signals are proportional to concentrations of free chlorine from .00001 to .01 M. The lower limit of detection of free chlorine by this method is .000002 M. The time required for a 98% response is 3 minutes. Free chlorine is selectively measured even in the presence of permanganate, chromate, combined chlorine and heavy metals. There are several advantages to this method. First, the calibration curve is linear over a wide range. Second, it is simple procedure that uses only HCl and NaOH as reagents, and third, it

uses direct measurement of free chlorine and therefore the other oxidant such as monochloramine which interferences with the membrane electrode and probably with the method of Balt does not interfere and can be determined separately. Response can be made 30-40% faster by shortening the tubes used in this system. In this case, 20 samples can be analyzed in an hour. (Baker-FRC)
W83-04192

SIMULTANEOUS DETERMINATION OF SIXTEEN MAJOR AND MINOR ELEMENTS IN RIVER SEDIMENTS BY ENERGY-DISPERSIVE X-RAY FLUORESCENCE SPECTROMETRY AFTER FUSION IN LITHIUM TETRABORATE GLASS,
University of Southern Colorado, Pueblo. Dept. of Chemistry.
K. I. Mahan, and D. E. Leyden.
Analytical Chimica Acta, Vol 147, p 123-131, 1983. 5 Tab, 16 Ref.

Descriptors: *Pollutant identification, *Sediments, *Trace elements, *X-ray fluorescence, X-ray spectroscopy, Fluvial sediments, Trace metals, Lake sediments, Arkansas River, Lake sediments.

Fluvial sediments, including the NBS SRM-1645 Standard River Sediment, were fused in lithium tetraborate to form glass discs on which 16 elements were determined simultaneously under a single set of x-ray conditions by energy-dispersive x-ray fluorescence spectrometry. In the NBS SRM-1645 samples, corrections were required for the fluroescence of chromium by the FeK lines and the absorption of FeK lines by chromium, and for background levels of manganese. At the lowest sample-to-flux ratio (1:10), good agreement was obtained between the results using the present method and the NBS values for all quantifiable elements except zinc. At higher sample-to-flux ratios, agreement with NBS values was generally poorer with increasing sample concentration. The relative standard deviation (RSD) of the eight quantifiable major and minor elements (K, Ca, Ti, Mn, Fe, Zn, Sr and Zr) determined under a single set of x-ray conditions ranged from 2 to 9% with a mean RSD of 4.4% for a set of replicate discs fused with Lake Pueblo/Arkansas River sediment samples. (Geiger-FRC)
W83-04194

EVALUATION OF METHODS BASED ON ACID EXTRACTION AND ATOMIC ABSORPTION SPECTROMETRY FOR MULTI-ELEMENT DETERMINATIONS IN RIVER SEDIMENTS,
University of Southern Colorado, Pueblo. Dept. of Chemistry.
G. S. Caravajal, K. I. Mahan, D. Goforth, and D. E. Leyden.
Analytica Chimica Acta, Vol 147, p 133-150, 1983. 5 Fig, 7 Tab, 57 Ref.

Descriptors: *Pollutant identification, *Trace elements, *Separation techniques, *Fluvial sediments, *X-ray fluroescence, Trace metals, Heavy metal, Sediments, X-ray spectroscopy.

A method is presented for the multi-element analysis of major, minor, and trace metals in sediments by mineral acid extraction and atomic absorption spectrometry (AAS). The technique was applied to the analysis of NBS SRM-1645 and river sediments for the determination of Li, Na, K, Rb, Mg, Ca, Sr, Fe, Mn, Cu, Cd, V, Co, Cr, Ni, As, Sb, Tl, Pb, Zn, Al, Hg and Mo. Results were compared with those obtained by lithium tetraborate fusion, energy-dispersive x-ray fluorescence spectrometry, and electrothermal AAS after digestion of the fused borosilicate glass. Although good accuracy was obtained for most of the elements, low values were obtained for Fe, Cd, Co, Sb and the alkali and alkaline earth metals due to incomplete extraction. A matrix modification technique was required for some minor elements and all trace elements except Mn and Zn. Although electrothermal AAS was effective for most minor and trace elements determined, it is inadequate for the dissolution of major elements in river sediments. (Geiger-FRC)
W83-04195

5B. Sources Of Pollution

THE ORIGIN OF CONTINENTAL SHELF AND SLOPE WATER IN THE NEW YORK BIGHT AND GULF OF MAINE: EVIDENCE FROM H2018/H2016 RATIO MEASUREMENTS,
Lamont-Doherty Geological Observatory, Palisades, NY.
R. G. Fairbanks.
Journal of Geophysical Research, Vol 87, No C8, p 5796-5803, July 20, 1982. 11 Fig, 21 Ref.

Descriptors: *Isotope studies, *Water circulation, *Bights, *New York Bight, Middle Atlantic Bight, *Gulf of Maine, *Saline water, Seawater, Meteoric water, Water currents, Melting, Sea ice, Ice, Oxygen isotopes, Continental shelf, Continental slope, Fate of Pollutants, Rivers, River water.

A combination of isotope and salinity tracers were used to study the general circulation of the seawater in the Middle Atlantic Bight. In this region the ratio of 018 to 016 in meteoric water decreases with increasing latitude. The annual average of the difference in 018 content for the Middle Atlantic Bight and Gulf of Maine rivers are -9.33 o/oo and -10.89 o/oo, respectively. All rivers are enriched by about 2 o/oo during the summer months. Five types of water were identified by isotope ratio measurements: slope water, Scotian shelf surface water, Gulf of Maine surface and intermediate water, cold pool, and New York Bight surface water. Slope water is imported to the New York Bight and is an extension of the Labrador Current. Upper slope water is a mixture of local shelf water and Gulf Stream water. Slope water is also found in the bottom of the Wilkinson Basin, Gulf of Maine. The New York Bight cold pool was renewed from the north during springtime. In March 1977 the cold pool contained as high as 2.75% melt water from sea ice originating in the Gulf of St. Lawrence. This isotope-salinity method can help predict the New York Bight hydrography by monitoring water upstream. (Cassar-FRC)
W83-03856

DECOMPOSITION OF SOLID WASTE IN TEST LYSIMETERS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W83-03861

EFFECT OF SEWAGE SLUDGE ON TRACE ELEMENT MOBILITY IN SOILS,
Institute for Soil Fertility, Groningen (Netherlands). Dept. of Soil Biology.
R. G. Gerritse, R. Vriesema, J. W. Dalenberg, and H. P. DeRoos.
Journal of Environmental Quality, Vol 11, p 359-364, 1982. 5 Fig, 4 Tab, 25 Ref.

Descriptors: *Adsorption, *Land application, *Sludge disposal, *Trace elements, Fate of pollutants, Land disposal, Heavy metals, Metals, Organic matter, Chelation, Leaching.

The adsorption (distribution between solid and liquid phases) of 26 trace elements was studied in the laboratory in a sandy soil and a sandy loam soil. Aqueous solutions used in the experiments were deionized water, salt solutions, supernatant of industrial anaerobically digested sludge, supernatant of domestic sludge, and supernatants of aerated sludges. F, B, and Tc were very mobile in both soils. Mn, Sr, and Sb were highly mobile only in the sandy soil; Mo in the sandy loam soil. In general sludge solutions increased the mobility of elements in a soil. This was attributed to complexation by organic compounds, high background concentrations, and high ionic strengths. The effects of these variables were very different among the elements. Equations were developed for predicting the rates of accumulation in soils and concentrations in soil solutions for the trace elements. Other elements studied were Be, V, Cr, Fe, Co, Ni, Cu, Zn, As, Se, Ag, Cd, Sn, Cs, Ba, Hg, Pb, Bi, and P. When adsorption was related to soil organic matter content, the strength of adsorption depended only on pH, increasing with decreasing pH for many elements. (Cassar-FRC)
W83-03893

USING EPA'S COMPUTERIZED DATA BASE (STORET) TO ANALYZE FOR AGRICULTURAL WATER POLLUTION,
Virginia State Water Control Board, Richmond. Bureau of Water Control Management.
J. C. Reardon, L. D. Hanson, and J. Randolph.
Journal of Environmental Quality, Vol 11, No 3, p 427-432, 1982. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Agricultural runoff, *Nonpoint pollution sources, *Farm management, Fate of pollutants, Water pollution sources, Phosphates, Nitrates, Nitrites, Coliforms, *STORET, Agricultural wastes, Animal wastes, Cultivation, Runoff, Little Bennett Creek, *Maryland, Farm wastes, Data storage and retrieval, Water quality control.

The computer data base STORET was used to retrieve stream water quality data for a 9-year period for the upper Little Bennett Creek watershed, Maryland. This agricultural watershed contains many large dairy farms which have waste management and storage facilities. During the study period the use of no-till and minimum-tillage corn practices increased by about 90%, and several operators improved their waste control facilities. STORET data from 4 sampling stations were used to relate concentrations of total phosphate, fecal coliforms, and nitrate-nitrite-N data to time. Linear regressions indicated that total phosphate and fecal coliforms decreased with time. Total phosphate data from all sampling stations showed a significant inverse relationship between concentration and time. Only the furthest-upstream station produced a significant relationship between fecal coliform concentrations and time. Nitrate-nitrite regression equations were not significant at any station. Use of the computerized information allowed analysis of data at about one-tenth the cost of a program requiring sampling and laboratory analysis. (Cassar-FRC)
W83-03895

MOBILITY THROUGH SOILS OF CERTAIN HEAVY METALS IN GEOTHERMAL BRINE WATER,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
H. E. Doner, A. Pukite, and E. Yang.
Journal of Environmental Quality, Vol 11, No 3, p 389-394, 1982. 2 Fig, 4 Tab, 17 Ref.

Descriptors: Metals, *Brines, Adsorption, Fate of pollutants, *Heavy metals, *Geothermal studies, Cadmium, Copper, Lead, Zinc, Manganese, Chlorides, Salton Sea, *California, Geochemistry, Soil adsorption capacity, *Path of pollutants.

Geothermal brine from the Salton Sea, California, field was applied to five agricultural soils in laboratory column tests to determine the mobility of heavy metals. Results indicated that accidental spills of the geothermal brine onto the soils of the Imperial Valley would result in contamination of drainage and ground waters with salt and heavy metals. No soils in the study adsorbed Cu(++) from the brine; Cd(++) was removed by some soils. Although all soils adsorbed some Pb(++) and Zn(++), their adsorption capacity was exceeded after passing 10 pore volumes of brine. As determined by the GEOCHEM program, complexation with chloride was extensive in all metals: 100% of Cd and Pb, 80% of Cu and Zn, and 54% of Mn. The high mobility of the heavy metals was attributed to mass action and chloride complexation. (Cassar-FRC)
W83-03896

HEAVY METAL CONCENTRATIONS IN EARTHWORMS FROM SOIL AMENDED WITH SEWAGE SLUDGE,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
W. N. Beyer, R. L. Chaney, and B. M. Mulhern.
Journal of Environmental Quality, Vol 11, No 3, p 381-385, 1982. 4 Tab, 19 Ref.

Descriptors: *Sludge disposal, Metals, *Invertebrates, Fate of pollutants, Worms, Cadmium, Zinc, Copper, Nickel, Lead, Food chains, Wildlife, *Heavy metals, Land application, Soil amendments, Indicator organisms, Bioindicators.

Earthworms in four agricultural fields amended with sewage sludge contained 12 times more Cd, 2.4 times more Cu, 2.0 times more Zn, and 1.2 times more Pb than at control sites. Ni levels were not elevated. Metals concentrations varied widely among the four sites. Average metals concentrations (ppm dry weight) in sludge exposed earthworms were: Cd, 57; Zn, 452; Cu, 31; Ni, 14; and Pb, 20. Average total metals levels (ppm dry weight) in soil were: Cd, 2.7; Zn, 132; Cu, 39; Ni, 19; and Pb, 31. Generally, Cd and Zn were concentrated by earthworms relative to the soil; Cu, Pb, and Ni were not. Liming the soil had no effect on Zn, Cu, Ni, or Pb levels in worms but reduced Cd concentrations by 40% in the most acidic soil and 11% on the average. Concentrations of Cd, Zn, Cu, and Pb (but not Ni) in earthworms were correlated with those in soil. The ratio of metals concentrations in earthworms/soil was lower in contaminated soil than in clean soil. (Cassar-FRC)
W83-03897

NITROGEN AND PHOSPHORUS MOVEMENT IN COMPOST-AMENDED SOILS,
Maryland Univ., College Park. Dept. of Agronomy.
J. C. Inman, M. S. McIntosh, J. E. Foss, and D. C. Wolf.
Journal of Environmental Quality, Vol 11, No 3, p 529-532, 1982. 4 Fig, 3 Tab, 25 Ref.

Descriptors: *Composting, *Sludge disposal, *Nutrients, Fate of pollutants, Nitrates, *Phosphates, Conductivity, Land application, Land disposal, Trees, *Nitrogen, *Path of pollutants.

Nitrate-N, phosphate-P, and electrical conductivity were monitored for 30 months after application of a composted sewage sludge (65% sludge and 35% wood chips) to a silt loam planted with plots of white pine or hybrid poplar. Sludge was applied on August 10, 1977, at the rate of 0, 150, or 300 dry tons per ha. Nitrate concentrations were highest during the first year following sludge application. In the C horizon (100 cm depth) levels were 11-12 micrograms per ml in the control and 70-80 micrograms per ml in the 300 tons per ha application. Within 2 years after sludge application the nitrate concentrations had declined to < 10 micrograms per ml. Total Kjeldahl N concentrations were 2 and 3 times higher than levels in control soils in the 150 and 300 tons per ha plots, respectively, a month after sludge application. By July 1980 only 3-6% of the total Kjeldahl N had been lost. Phosphate concentrations were generally below 0.08 micrograms per ml in all plots. Average electrical conductivity (EC) values (in micromhos per cm) were: A horizon, 542; B horizon, 405; and C horizon, 694. No visible salt injury was apparent in the pines, poplars, or fescue. On day 267 after application EC values (micromhos per cm) were 1000 in the 300 tons per ha treatment, 700 in the 150 tons per ha treatment, and 200 in the control. By the second spring after application EC had declined to < 400 micromhos per cm on the composted plots. (Cassar-FRC)
W83-03898

WATER QUALITY AND NUTRIENT DYNAMICS OF ARIZONA STREAMS,
Arizona State Univ., Tempe. Dept. of Zoology.
S. G. Fisher, and N. B. Grimm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253369, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Arizona, Tucson, July 1983. 64 p, 4 Fig, 39 Tab, 29 Ref. OWRT A-106-ARIZ(1), 14-34-0001-1103.

Descriptors: Water quality, *Nitrogen, *Phosphorus, Stream channels, *Arizona, *Nutrients, Streams, Pollutant identification, Water pollution sources, Fate of pollutants.

This reports an investigation of water quality of Arizona streams and rivers with special attention given to nutrient concentrations and dynamics. Samples from one hundred ninety-six sites of 157 streams in Arizona were analyzed chemically with emphasis on nitrogen and phosphorus. Both N and P vary considerably, but N concentrations of floodwater and spring-source sites are significantly higher than sites samples at summer low flow. Nitrate-N declines downstream of spring-sources faster than P, so that N:P at downstream (summer low flow) sites is <15 suggesting potential N limitation. This decline of N is explainable by autotrophic uptake, based on measurements of net production for a stream segment ecosystem and of N uptake by isolated algal communities. Diel nitrogen and phosphorus budgets measured for a 100-m segment of Sycamore Creek, a low desert stream, on three dates during a 30-day recovery period following flash flood decimation of the biota. Transport was dominated by dissolved N and P. Retention of dissolved nutrients by the ecosystem increased with succession, while export of particulate N and P represented a minor loss at later stages of succession. Overall, the results of this study lend support to two hypotheses: (1) If nutrients are limiting to production in Arizona streams, N is the likely candidate. (2) Floodwaters and springs are sources of high N concentration, but reduction of N occurs after floods and downstream of springs, probably due to autotrophic uptake.
W83-03900

AN ANALYTICAL MODEL OF CONTAMINANT MIGRATION IN SHALLOW AQUIFERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
D. O. Lederer, D. W. Ostendorf, R. R. Noss, and D. D. Adrian.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255505, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 139, Massachusetts Univ., Amherst, May 1983. 70 p, 16 Fig, 11 Tab, 20 Ref. OWRT A-131-MASS(1), 14-34-0001-0123.

Descriptors: *Leachate, *Subsurface flow, *Aquifer management, *Simulation, *Monitoring, Groundwater pollution, Groundwater movement, Percolation, Waste disposal, Model studies, Landfills, Water measurement, Groundwater, New York, Massachusetts, *Path of pollutants.

This study is an attempt to create an easily employable, one-dimensional model of leachate movement away from large, diffuse sources such as sanitary landfills, over long time periods in shallow aquifers. The approach used is one in which a number of lumped parameter cells are placed in series to simulate plug flow in the groundwater system. The lumped parameter modelling scheme models time very carefully, yet describes space on an average basis. After solution of the governing differential equations, the model is verified using data from Babylon, New York and Amherst, Massachusetts landfills.
W83-03909

ASSESSMENT OF ACIDITY OF LAKES AND PRECIPITATION IN THE SIERRA NEVADA,
California Univ., Santa Barbara. Marine Science Inst.
J. M. Melack.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255521, Price codes: A04 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, June 1983. 62 p, 14 Fig, 6 Tab, 65 Ref, 2 Append. OWRT-A-080-CAL(1).

Descriptors: *Acid rain, *Lakes, *Mountain lakes, Acidic water, Acids, Precipitation, Environmental effects, Pollution effects, Air pollution effects, Aquatic environment, *California, Sierra Nevada, Oligotrophic lakes.

The east central Sierra Nevada received acid precipitation (pH 3.7 to 4.9) during the convective storms interspersed through the dry seasons of 1981 and 1982. In contrast, late autumn, winter and early spring snow (1981-82) ranged in pH from 5.2 to 6.1 (mean 5.7) and had low ammonium, nitrate and sulfate concentrations. As of 1981 most of the alpine lakes of the Sierra Nevada remain very weakly buffered, bicarbonate lakes that receive a small loading of acid precipitation and a large annual input of snowmelt uncontaminated by strong acids. These lakes contain low concentrations of orthophosphate, nitrate and ammonium and are oligotrophic. The zooplankton communities fall into two major groups, those dominated by large-bodied species in the absence of fish, and those dominated by smaller species where fish are present. If the acidity of the precipitation increases the pH of the lakes will decrease rapidly with adverse biological impacts because the lakes and their basins have extremely low buffer capacity and the biota cannot tolerate acidic water. (Snyder-California)
W83-03911

MULTIPORT DIFFUSER DESIGN FOR DISCHARGING POLLUTANTS IN ALABAMA'S RIVERS,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W83-03912

RAW WATER BROMIDE: LEVELS AND RELATIONSHIP TO DISTRIBUTION OF TRIHALOMETHANES IN FINISHED DRINKING WATER,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 5F.
W83-03916

EFFECTS OF DETERGENT FORMULATION ON THE PERFORMANCE OF SEPTIC SYSTEMS,
J. M. Harkin, B. Al-Hajjar, and D. G. Kroll.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-257543, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center Publication No WIS WRC 83-09, 1983. 64 p, 1 Fig, 8 Tab, 53 Ref, 2 Append. OWRT B-108-WIS(1), 14-34-0001-0257.

Descriptors: *Septic Wastewater, *Detergents, *Phosphorus, Nitrates, Ammonium, Bacteria, Solids, Conductivity, Hydrogen ion concentration, Temperature, *Carbonate detergent, *Septic tanks, Wastewater treatment, Water quality control.

The intent of this study was to monitor the condition on a monthly basis of closely matched new septic systems and to examine their effects on the quality of groundwater, depending on whether laundry was washed in phosphate or carbonate detergent. The septic tank exerts a buffering effect that overcomes the differences that phosphate or carbonate builders create. Virtually no differences are observed in average pH or alkalinity in the tank. However, differences are observed in numbers of indicator organisms; counts for total coliforms, fecal coliforms and fecal streptococci are 1.4, 2.9 and 4.5 times higher in effluent from systems receiving P detergents. Of greatest importance to water quality are the P data. For the first time, reliable estimates can be given of the relative contribution of P from detergents to household wastewater. Hitherto estimates have been based on values for municipal wastewater, which is confounded by P inputs from industrial plants or hospitals, where P detergents were permitted despite bans on household use. 40% of the P in sewage comes from laundering. More important is that groundwater contamination by P did not occur at any site regardless of whether P-built or P-free deterget was used. Obviously all of the P in septic tank effluent is removed by soil, regardless of its sandy texture at each site. Apart from ammonium or nitrate contamination, septic systems have only minor effects on groundwater. For nitrate it is irrelevant which detergent is used. Nitrate levels in groundwater near systems deploying periodic pressurized dosing are lower than for those under randomly dosed conventional systems. In sum-

mary, it makes little difference to the operation, performance, or biological clogging of a septic system whether the household uses exclusively P- or P-free detergents. Neither type of detergent results in entry and movement of P into groundwater.
W83-03924

THE INFLUENCE OF SURFACTANTS ON THE ADSORPTION OF HEAVY METAL IONS BY CLAYS,
Newcastle Univ. (Australia). Dept. of Chemistry.
A. Beveridge, and W. F. Pickering.
Water Research, Vol 17, No 2, p 215-225, February, 1983. 6 Fig, 1 Tab, 26 Ref.

Descriptors: *Heavy metals, *Surfactants, *Adsorption, *Clays, Copper, Zinc, Lead, Cadmium, Ions, Suspended solids, Fate of pollutants, Laboratory studies.

The effects of low concentrations of a series of anionic, cationic, and nonionic surfactants available commercially on the uptake of copper, lead, zinc, and cadmium by three types of clays (kaolinite, illite, and a montmorillonite) were investigated over the pH range 3 to 10. The phase distribution process was influenced by low concentrations (less than 0.005% weight/volume) of charged surfactants, but much higher concentrations (greater than 0.1% weight/volume) of nonionic species were necessary to produce observable effects. The cationic surfactants reduced metal ion uptake by montmorillonite suspensions by competing for surface sites, but had much smaller effects on metal ion uptake by the other two clays. The addition of anionic surfactants led to increased metal loss from solution, probably as a result of precipitation of sparingly soluble metal-surfactant species. The effects of the nonionic organics studied (all ethoxylates) varied with the type of clay and the specific metal ion involved. The concentrations used were of the order required for micelle formation, and it appears that the micelles became involved in the metal ion distribution process. The presence of surfactant reduced the amount of metal ion sorbed by montmorillonite clays, but evidence of a reduction in adsorption site availability in kaolinite and illite suspensions was apparent in only a few of the systems studied. Most of the remaining systems caused some enhanced loss of the metal ion form solution. Few of the added surface active agents significantly influenced the pH at which the metal ions precipitated as hydroxy species. It is suggested that, since the more widely used surfactants in detergent preparations tend to be anionic species, contamination of waterways by these materials will have at least one beneficial effect: namely, that the levels of heavy metal ions in solution should either be reduced or remain unaltered. (Carroll-FRC).
W83-03935

DYNAMIC ESTIMATES OF RIVER POLLUTION UNDER CONDITIONS OF REGULATION OF THE RIVER AND ANTHROPOGENIC RUNOFF,
I. V. Gordin.
Water Resources (English Translation), Vol 8, No 4, p 402-409, July/August, 1981. 4 Fig, 7 Ref. Translated form Vodnye Resursy, No 4, p 108-117, July/August, 1981.

Descriptors: *Fate of pollutants, *Dynamics, Mathematical studies, Concentration, Water management, Water quality control, Mathematical equations, Monitoring, Rivers, Water pollution sources, Runoff, Streamflow, *USSR.

To aid in optimizing water-quality regulation in water conservation systems, the change in concentration of a given pollutant at a certain control section with time was investigated mathematically. The problem of the optimal regulation of water quality is formulated with respect to three criteria of statistical dynamics: the maximum value of the concentration, the integral value during the period of interest, and the integral square value. The calculations suggest that the problem of a dynamic estimate of the pollution of rivers under conditions of regulating the river and anthropogenic runoff apparently cannot be solved uniquely by developing a universal criterion. At the same time, the estimates examined in the paper give a sufficiently clear idea about the comparative effectiveness of various methods of regulation and reveal interesting regularities of water quality management in industrially polluted streams. (Baker-FRC)
W83-03937

CHEMICAL WATER QUALITY OF RUNOFF FROM GRAZING LAND IN NEBRASKA: II CONTRIBUTING FACTORS,
Agricultural Research Service, Lincoln, NE.
J. S. Schepers, B. L. Hackes, and D. D. Francis.
Journal of Environmental Quality, Vol 11, No 3, p 355-359, 1982. 1 Fig, 5 Tab, 10 Ref.

Descriptors: *Grazing, *Farm wastes, *Nonpoint pollution sources, Farm management, Livestock, Pastures, *Nebraska, Precipitation, Runoff, Agricultural runoff, Water quality, Animal wastes, Manure, Vegetation, Wildlife, Nutrients, Organic matter, Nitrates, Phosphorus, Chlorides, Ammonium, Water pollution sources, Fate of pollutants, Pastures.

The effects of climatic factors, hydrologic factors, and management practices on the chemical quality of runoff from a 32.5 ha cow and calf pasture in Nebraska were studied in 1976-78. Precipitation and hydrologic characteristics, stocking rates, and sediment contents in the runoff were used to predict the average concentrations of ammonium-N, nitrate-N, Kjeldahl N, soluble P, total P, total organic carbon, COD, and chloride. Animal stocking density significantly influenced the predicted concentrations of ammonium-N, nitrate-N, total P, total organic carbon, and COD in the runoff. However, dilution was the dominant process. Likely sources of pollutants were standing plant material and manure. Chloride appeared to be an indicator of wildlife activity. (Cassar-FRC)
W83-03967

PLANT AND SOIL REACTIONS TO NICKEL ORE PROCESSED TAILINGS,
Oregon State Univ., Corvallis. Dept. of Soil Science.
P. J. Sheets, V. V. Volk, and E. H. Gardner.
Journal of Environmental Quality, Vol 11, No 3, p 446-451, 1982. 2 Fig, 5 Tab, 31 Ref.

Descriptors: *Nickel, *Mine wastes, *Revegetation, Metals, Heavy metals, Plant growth, Water pollution effects, Water pollution sources, Ammonium, Conductivity, Dissolved solids, Grasses.

The effect of nickel ore tailings, produced by a proposed reduction-leaching procedure, on plant growth and soil properties was studied. The tailing material contained high levels of some heavy metals, ammonia, and soluble salts and low concentrations of P and Ca. Magnesium and ammonium sulfates were largely responsible for the high electrical conductivity of the tailings, 8.4 mmhos per cm. Ammonium-N was 877 micrograms per g; Ni, 0.28%, Cr, 0.44%; and Fe, 32%. Five pore volumes were required to reduce the electrical conductivity to 0.8 mmhos per cm, acceptable for irrigation water. Tall fescue was grown in green house experiments, using the local serpentinic soil and tailings added at the rates of 0, 22, 446, and 669 g per kg soil as well as in 100% tailings. Establishment of the grass was slow on soils amended at the highest rate and on pure tailings because of the high levels of soluble salts and ammonia. However, total seasonal yields of dry matter were comparable in all treatments. It was recommended that the tailings be washed to reduce ammonia and soluble salts before revegetation and that native soil be added to reduce crusting. (Cassar-FRC)
W83-03976

A PROPOSAL FOR ESTIMATION OF SOIL LEACHING AND LEACHING CONSTANTS FOR USE IN ASSESSMENT MODELS,
Oak Ridge National Lab., TN.
C. F. Baes, III, and R. D. Sharp.
Journal of Environmental Quality, Vol 12, No 1, p. 17-28, January/March, 1983. 7 Fig, 5 Tab, 85 Ref.

Descriptors: *Solute transport, *Leaching, *Fate of pollutants, Model studies, Infiltration, Distribution coefficient, Soil properties, Soil density.

A model to predict annual average, order of magnitude leaching constants for solutes in agricultural soils is developed. The leaching constants, which are solute- and location-specific, are usable in exposure, dose, or risk assessment models to account for removal from the root zone by leaching. The model relates annual average water infiltration with soil bulk density and porosity and the solute's distribution coefficient. Annual infiltration is determined from site-spcific estimates of total precipitation, irrigation, and evapotranspiration. Soil bulk density and porosity have geometric mean values of 1.35 g per cu cm and 0.48 cu cm per cu cm, respectively, and vary within a factor of 3. The solute distribution coefficient varies widely and unpredictably, depending on solute and soil characteristics, especially pH. A table lists ranges of distribution coefficients for 27 elements in a variety of soils and from pH 4.5 to 9.0. For example, the distribution coefficient for plutonium varies between 11 and 300,000. Leaching constants predicted for Pu, Sr, and Tc were within an order of magnitude of observed data for 8 comparisons, except for 1 study involving Pu. (Cassar-FRC)
W83-03978

DETERMINATION OF ALGAL-AVAILABLE PHOSPHORUS ON SOIL AND SEDIMENT: A REVIEW AND ANALYSIS,
Pennsylvania Univ., Philadelphia. Dept. of Civil and Urban Engineering.
D. A. Hegemann, A. H. Johnson, and J. D. Keenan.
Journal of Environmental Quality, Vol 12, No 1, p 12-16, January/March, 1983. 63 Ref.

Descriptors: *Sediments, *Phosphorus, *Algae, Reviews, Soil, Nutrients, Bioassay, Agricultural runoff, Phosphates, Fate of pollutants, Lake sediments, Bottom sediments.

Recent research on algal-available phosphorus associated with soil and sediments is reviewed. The bioassay and chemical fractionation procedures were nonuniform and involved site-specific soils, making quantitative comparisons difficult. Many studies showed that some of the Fe- and Al-bound P is available to algae in bioassays. However, it has not been shown that all the P extracted from the non-apatite fraction is algal-available. Stable organic P in soils and sediments appears to be of very limited availability, depending on environmental conditions and the degree of bacterial action, which liberates orthophosphate. It is reported that from 0 to 80% of total soil P is available to algae. The short-term batch culture assays most likely do not identify the total quantity of algal-available P. Longer-term experiments (longer than 100 days) would probably give more accurate results. (Cassar-FRC)
W83-03979

ADSORPTION AND DEGRADATION OF PHENOL AT LOW CONCENTRATIONS IN SOIL,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
H. D. Scott, D. C. Wolf, and T. L. Lavy.
Journal of Environmental Quality, Vol 12, No 1, p 91-95, January/March, 1983. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Phenol, *Adsorption, *Degradation, Fate of pollutants, Biodegradation, Microbial degradation, Soil.

Degradation rates and half-lives of phenol in silt loams were essentially independent of concentration over the range 94 ng per g to 94 microg per g of soil. However, mean degradation rates differed between the 2 soils, 0.260 and 0.198 per hour. Half-lives for the 2 soils were 2.70 and 3.51 per hour. For sterile soil the adsorbed concentration was more variable than the solution concentration. For nonsterile soil the variabilities of adsorbed and solution concentrations were greater than for sterile soil. Freundlich K values increased to a maximum at 12 hours of equilibration between phenol and both soils. Little or no effect was found on the

Freundlich N values. Data suggest that sterilization of soil increases the precision of adsorption measurements. (Cassar-FRC)
W83-03980

CHEMICAL WATER QUALITY OF RUNOFF FROM GRAZING LAND IN NEBRASKA: I. INFLUENCE OF GRAZING LIVESTOCK,
Agricultural Research Service, Lincoln, NE.
J. S. Schepers, and D. D. Francis.
Journal of Environmental Quality, Vol 11, No 3, p 351-354, 1982. 3 Tab, 18 Ref.

Descriptors: *Grazing, *Farm wastes, *Nonpoint pollution sources, Pastures, *Nebraska, Runoff, Water quality, Farm management, Animal wastes, Manure, Vegetation, Wildlife, Nutrients, Organic matter, Nitrates, Phosphorus, Chlorides, Ammonium, Water pollution sources, Fate of pollutants, Livestock.

The quality of runoff water from a 32.5 ha cow and calf pasture in Nebraska was studied for three years, 1976-78. Three types of pastures were included: ungrazed pasture (control), grazed pasture with livestock actively grazing, and grazed pasture with livestock absent. The runoff water from pasture with actively grazing livestock had higher concentrations of all water quality parameters with respect to the grazed pasture with no livestock present, with the exception of Kjeldahl N, which decreased by 19%. The increases were: total solids, 52%; total organic carbon, 11%; COD, 7%, ammonium-N, 6%, nitrate-N, 45%; total P, 37%; soluble P, 48% and chloride, 78%. Runoff from the control area was tea-colored and had the poorest quality, with 1.94 to 10.8 times greater concentrations of pollutants. This was attributed to wildlife activity and leaching of nutrients and organic matter from vegetation. (Cassar-FRC)
W83-03981

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: V. PESTICIDE USE IN 11 AGRICULTURAL WATERSHEDS AND PRESENCE IN STREAM WATER, 1975-1977,
Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
R. Frank, H. E. Braun, M. V. H. Holdrinet, G. J. Sirons, and B. D. Ripley.
Journal of Environmental Quality, Vol 11, No 3, p 497-505, 1982. 13 Tab, 35 Ref.

Descriptors: *Pesticides, *Agricultural watersheds, *Great Lakes, *Ontario, Insecticides, Herbicides, Fungicides, Nematocides, Fate of pollutants, Atrazine, Water qualtity, Streams, Watersheds, Pollution load, Agricultural runoff, Runoff, Water pollution sources, Nonpoint pollution sources.

A survey of pesticide use in 11 agricultural watersheds in southern Ontario showed that 81 pesticides were applied during 1975 on 39% of the land surface at a rate of 8.27 kg per ha per year. This was equivalent to 3.25 kg per ha per year over the whole area. Analysis of stream water samples from the 11 watersheds revealed 41 pesticides that were on the list of materials applied. Drainage waters contained 18 parent compounds, 3 metabolites, and 1 industrial organic pollutant. DDT, TDE, and HEOD were identified in water samples although they have not been used for several years. Several pesticides (atrazine, endosulfan, and simazine) were persistent enough to appear in water samples throughout the year. The overall unit area loading to streams by pesticides was 2.18 g per ha per year, of which atrazine accounted for 2.01 g per ha per year. Pesticides entered the stream water from storm runoff waters (60%), in base flow from internal soil drainage (18%), and from spills adjacent to streams (22%). Those chemicals whose levels exceeded the International Joint Commission water quality standards were polychlorobiphenyls (78% of samples), total DDT (41% of samples), HEOD (16% of samples), endosulfan (14% of samples), and heptachlor epoxide (14% of samples). (Cassar-FRC)
W83-03982

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: I. REPRESENTATIVE AGRICULTURAL WATERSHEDS,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
D. R. Coote, E. M. MacDonald, W. T. Dickinson, R. C. Ostry, and R. Frank.
Journal of Environmental Quality, Vol 11, No 3, p 473-481, 1982. 1 Fig, 8 Tab, 16 Ref.

Descriptors: *Agricultural watersheds, *Great Lakes, *Ontario, Monitoring, Water quality, Pollution loads, Fate of Pollutants, Water pollution sources, Nonpoint pollution sources, Watersheds, Clays, Streams, Agricultural runoff, Runoff, Erosion, Fertilizers, Tile drainage, Livestock, Animal wastes, Farm wastes, Farm management, Land use.

Eleven representative agricultural watersheds in the southern Great Lakes drainage basin were chosen for monitoring as part of the PLUARG study on pollution loads. The regions were separated according to an index measuring the soil's potential to transfer pollutants to surface and groundwater. This index was strongly correlated with soil clay content. Study regions were 1,990 to 7,913 ha in area, 22 to 89% cultivated, 0 to 99% tile drained, 10 to 66% row-cropped, and stocked with up to 0.77 units of livestock per ha. During January-April 32% of the annual precipitation and 65% of the stream discharge were measured. Erosion potential was significantly positively correlated with row crops, fertilizer N, and tile drainage density. (Cassar-FRC)
W83-03983

COMPARATIVE MOVEMENT OF DIFFERENT ENTEROVIRUSES IN SOIL COLUMNS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
J. C. Lance, C. P. Gerba, and D. -S. Wang.
Journal of Environmental Quality, Vol 11, No 3, p 347-351, 1982. 4 Fig, 4 Tab, 15 Ref.

Descriptors: *Viruses, *Wastewater disposal, *Adsorption, Fate of pollutants, Land application, Soil absorption capacity, Coliforms, Bacteria, Enteroviruses, *Path of pollutants.

Secondary sewage effluents seeded with Echo 1, Echo 29, and Polio 1 viruses were applied to 250 cm long soil columns to study adsorption and leaching patterns. Adsorption in the top 2 cm of soil was 90% for Echo 29 and Polio 1, 77% for Echo 1. All three viruses similarly below the 40 cm depth, at which about 1% of virus remained. At the 160 cm depth, virus removal was >99.9%. Virus leaching patterns reacted similarly to changes in virus concentration and flow velocity. Virus removal efficiencies varied widely among three sand and sandy loam soils, but the leaching patterns of the viruses were similar for a given soil type. The fates of fecal coliforms and poliovirus were roughly parallel, with more viruses than coliforms being removed in the surface layer. At the 130 cm depth removal of both coliforms and viruses was >99.9%. (Cassar-FRC)
W83-03984

DISPOSAL OF FEEDLOT-LAGOON WATER BY IRRIGATING BROMEGRASS: II. SOIL ACCUMULATION AND LEACHING OF NITROGEN,
Kansas Agricultural Experiment Station, Manhattan. Dept. of Agronomy.
R. V. Olson, R. V. Terry, W. L. Powers, C. W. Swallow, and E. T. Kanemasu.
Journal of Environmental Quality, Vol 11, No 3, p 400-405, 1982. 5 Fig, 5 Tab, 15 Ref.

Descriptors: *Wastewater irrigation, *Nitrogen compounds, *Leaching, *Bromegrass, Grasses, Feedlot wastes, Animal wastes, Farm wastes, Irrigation, Nitrates, Fate of pollutants, Ammonium, Denitrification.

Beef feedlot lagoon water was applied to bromegrass fields at the rates of 0, 2.5, 5.1, 7.6, and 10.2 cm per irrigation on 17 occasions over a 4 year period. N concentrations of the applied water varied from 23 to 222 mg per liter, with 1 to 141 mg per liter nitrate-N. Total N contents in the profile increased during the experiment with the 1.2 cm treatment and decreased with the 5.1 cm treatment. At the end of the experiment 56.7 kg N per ha of the 945 kg per ha applied in the 5.1 cm treatment and 136.1 kg per ha of the 1890 kg per ha applied in the 10.2 cm treatment had leached below 105 cm. The amounts of N leached and the N levels in the leachate were not sufficient to adversely affect groundwater quality in the plots during the study period. The linear relationship between amounts of labeled ammonium-N added and labeld N found in the 0-70 cm layer was highly significant. Most of the labeled N was in the top 10 cm, 88-94% of it immobilized in the organic form. With the 5.1 cm treatment 28% of the labeled N applied as ammonium was in the soil profile, 41% was used by the crop, 31% lost as a gas, and 0.7% leached below 105 cm. With the 10.2 cm treatment 20% was in the soil, 38% used by the crop, 40% lost as gas, and 1.3% leached. (Cassar-FRC)
W83-03986

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: II. FLUVIAL SEDIMENTS,
Department of Agriculture, Guelph (Ontario). Inst. of Pedology.
G. J. Wall, W. T. Dickinson, and L. J. P. Van Vliet.
Journal of Environmental Quality, Vol 11, No 3, p 482-486, 1982. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Agricultural watersheds, *Great Lakes, *Suspended sediments, *Ontario, Sediments, Erosion, Fate of pollutants, Water pollution sources, Nonpoint pollution sources, Agricultural runoff, Runoff, Watersheds, Water quality, Streams, Farm management, Pollution load.

A study of 11 small agricultural watersheds in southern Ontario showed that unit area yields of suspended sediments ranged from < 100 to 1000 kg per ha per year during 1976-76. Bank erosion contributed an estimated 0 to 30% of the suspended sediment; cropland sheet and rill erosion, 70-100%. Regression analysis of 14 watershed characteristics vs. unit area yields showed that % clay of the surface soil and % row crop were the most significant factors in estimating suspended sediment yields. Three methods for predicting suspended sediment yields were compared: a regression equation developed from the watershed studies, extrapolation of measured unit are yields obtained from the agricultural watersheds to similar areas in the Grand and Saugeen basins, and the Universal Soil Loss Equation plus a delivery ratio. The third method proved unsuitable for the Canadian climate. Suspended sediment yield from agricultural land in each of 300 subwatersheds in the lower Canadian Great lakes Basin was determined by extrapolation. Estimated suspended sediment yield from agricultural land in the southern Ontario portion of the Great Lakes basin was 652,872 tons per year: almost 300,000 tons per year each into Lakes Huron and Erie, the remainder into Lake Ontario and Georgian Bay. (Cassar-FRC)
W83-03987

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: IV. NITROGEN,
Department of Agriculture, Summerland (British Columbia). Research Station.
G. H. Neilsen, J. L. B. Culley, and D. R. Cameron.
Journal of Environmental Quality, Vol 11, No 3, p 494-497, 1982. 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Agricultural watersheds, *Great Lakes, *Nitrogen, *Ontario, Watersheds, Pollution load, Water polution sources, Nonpoint pollution sources, Fate of pollutants, Animal wastes, Farm wastes, Water quality control, Streams, Nitrates, Farm management, Clays, Agricultural runoff, Runoff, Fertilizers, Seasonal variation, Livestock.

Total Kjeldahl N and nitrate-N were sampled in stream runoff in 11 agricultural watersheds in southern Ontario during 1975-76. Of the 3000 sam-

ples, nitrate levels exceeded the 10 mg per liter drinking water standard in 3%. About half of the high concentrations occurred June and July storms and were associated with intense agricultural land use. Average annual total nitrogen stream loads were 3.5 to 29.2 kg N per watershed ha for the years 1975 and 1976. Nitrate accounted for an average of 75% of the total stream N loads. Both nitrate and total N loads were significantly correlated with addition of N to the watershed and with % of watershed under cultivation, in row crops and corn, or tile drained. Total N was also correlated with surface soil clay content and with extent of soils with high surface runoff potential. It was recommended that stream N loading be reduced in watersheds where loading greatly exceeds inputs of N from precipitation. In these watersheds the greatest potential for reducing N loads is improved fertilizer efficiency in corn production. Athough manure storage areas and feedlots did not contribute greatly to total N loads, proper waste management methods are important. 71% of the nitrate-N and total N loading occurred in January-April. (Cassar-FRC)
W83-03988

MINERALOGICAL CONTROLS ON TOXIC ELEMENT CONTAMINATION OF GROUNDWATER FROM BURIED ELECTRICAL UTILITY SOLID WASTES: I. SOLID WASTE MINERALOGY II. LITERATURE REVIEW OF FLY ASH MINERALOGY,
North Dakota State Univ., Fargo.
G. J. McCarthy, K. D. Swanson, P. J. Schields, and G. H. Groenewold.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265116, Price codes: A04 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State Univ., Fargo, August 1983. 59 p, 7 Tab, 36 Ref. OWRT A-078-NDAK(1), 14-34-0001-2136.

Descriptors: *Mineralogy, *Coal mine wastes, Wastes, Water pollution sources, Fly ash, X-ray diffraction, Quartz, Anhydrite, Lime, Water treatment, *North Dakota, *Groundwater pollution, Waste disposal.

Knowledge of the mineralogy of coal conversion wastes is essential science underlying either environmentally safe disposal or utilization of these wastes. Groundwater contamination is possible if these wastes are not disposed of properly. The fly ash samples from the Milton R. Young (MRY) and Coal Creek (CC) plants were dominantly noncrystalline glass. X-ray diffraction was used to identify the following crystalline phases in both samples: quartz, periclase, ferrite spinel, anhydrite and lime. The MRY fly ash also had alkali sulfates and a small amount of melilite solid solution phase. Devitrification treatments and water treatments aided in these phase identifications. The possible presence of tricalcium aluminate (C A) was noted but this phase could not be unambiguously identified in any of the x-ray diffractograms. The implications of these results for groundwater quality and utilization of these solid wastes is discussed. In addition to the mineralogy studies, ash buried as much as twelve years ago at the mine site adjoining the MRY plant was collected as undisturbed core that incorporated the materials above and below the ash disposal horizon. The sealed core samples are being kept frozen in anticipation of a follow-up investigation of the changes in mineralogy and migration of species from the buried waste.
W83-04004

ALTERATION OF AVAILABILITY OF HEAVY METALS TO AQUATIC MICROFLORA BY COMPLEXATION WITH ORGANICS ASSOCIATED WITH OIL SHALE DEVELOPMENT,
Utah Water Research Lab., Logan.
B. S. Mok, and J. J. Messer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265132, Price codes: A07 in paper copy, A01 in microfiche. Water Quality Series UWRL/Q-83/05, May 1983. 135 p, 33 Fig, 27 Tab, 110 Ref, 5 Append. OWRT A-051-UTAH(1), 14-34-0001-1147.

Descriptors: *Heavy metals, *Copper, *Cadmium, *Oil shale, *Leachates, Water pollution sources, Nickle, Humic acids, Fulvic acids, Detoxification, Bioassay, Toxins, Nutrients, *Algal bioassay, Water pollution effects, *Selenastrum.

Oil shale process waters and leachates were examined to determine their propensity to complex with heavy metals and create environmentally harmful soluble toxic substances. Leachates from both raw (unretorted) and Paraho retorted oil shale showed tha ability to bind copper, and perhaps cadmium, strongly enough to mitigate the normally inhibitory effects of these metals on the growth of the test alga, Selenastrum capricornutum. In contrast, no detoxification of nickel was observed. For both leachates, the organic fraction large enough to be retained by a UM2 ultrafilter was stimulatory to algal growth both in the presence and absence of added metals, possibly because they supply trace metal nutrients (e.g. iron) or detoxify trace metal toxicants (e.g. copper) through complexation equilibria. The smallest size fraction of the raw shale leachate, consisting of inorganic ions and small organic ions capable of passing a UM2 ultrafilter, was highly toxic to the test alga. The corresponding fraction of retorted shale was less toxic. The nature of the copper complexation by the oil shale leachate organics suggests the binding of this metal by natural humic and fulvic acids in aquatic systems. The complexation does not appear to be caused by the low-molecular weight ring-N compounds characteristic of retort water. Oil shale leachates are thus only likely to increase copper and cadmium binding and transport significantly in waters whose total organic carbon concentration exceeds that contributed by natural humic and fulvic materials.
W83-04006

THE CONTAMINATION AND PROTECTION OF AQUIFERS,
National Hydrology Research Inst., Ottawa (Ontario).
R. E. Jackson.
Nature and Resources, Vol 1, No 3, p 2-6, July/September, 1982. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Aquifer management, *Water pollution sources, Water pollution control, Regulations, United Nations, Groundwater, Water supply, Hydrocarbons, Nitrates, Heavy metals, Organic compounds, Industrial wastes.

The growing presence of contaminants in major water resources such as lakes or rivers and the pollution of aquifers underlying many cities in the world make proper management of groundwater imperative. Scientific evidence suggests that the continued and poorly regulated disposal of waste in dumpsites, landfills, deep wells, lagoons and other places is producing progressive and largely irreversible contamination of groundwater. Of particular concern is the apparent accumulation and persistence in groundwater of hydrocarbons from accidental spills and leaks; nitrate derived from groundwater activities; and heavy metals and toxic organic compounds from industrial operations. For the less developed countries a fourth concern must be added, that of bacterial contamination of shallow wells by seepage from nearby sanitation units. Although naturally occurring physical, chemical and bilogical processes may attenuate contaminants, these processes have finite limits do not lead in many cases to the self-purification of the contaminated groundwaters. Government regulation of waste-disposal activities and protection of aquifer systems along European lines is one possible solution. However, organizations such as MNESCO, through its International Hydrological Program, are working to sensitive hydrogeologists, engineers and public health officials to the dangers of allowing contamination to grow unchecked and to ways of protecting this resource. (Baker-FRC)
W83-04020

INTERFLOW OF WATER THROUGH A SLOPING SOIL WITH SEEPAGE FACE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2G.
W83-04040

HEAVY METALS IN MARINE ORGANISMS OF THE NORTH AEGEAN SEA, GREECE,
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
G. Vasilikiotis, K. Fytianos, and A. Zotou.
Chemosphere, Vol 12, No 1, p 75-81, 1983. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Heavy metals, *Marine animals, Lead, Mercury, Cadmium, North Aegean Sea, *Greece, Fate of pollutants, Spectrophotometry.

Concentrations of heavy metals were measured in marine organisms to determine whether they contained concentrations which would be hazardous to human health. All the marine organisms examined had a Cd concentration of less than 0.2 ppm. Highest lead values were 950 micrograms/kg and were found in the Kavala Gulf and in Thermaikos Gulf, which are the most highly polluted of the sampling areas. Mercury concentrations varied according to the sampling area. It was concluded that the concentrations of the heavy metals investigated in marine organisms were relatively low and close to those found in literature for unpolluted regions. The findings also show that the heavy metal concentrations are considerably higher near industrial areas and in ports. From these findings it is concluded that the Strymonikos Gulf is still unpolluted in comparison to the other two areas examined. No seasonal functuations were noted at any of the sites. Comparing the present values to those obtained during 1977-1980 for the same species and sampling areas, it is noted that a slight increase in mercury and lead concentrations occurred in all samples. Cadmium concentration was slightly decreased, but only in fish tissues. (Baker-FRC)
W83-04051

PHOTOLYSIS OF NITROAROMATICS IN AQUATIC SYSTEMS. I. 2,4,6-TRINITROTOLUENE,
SRI International, Menlo Park, CA. Physical Organic Chemistry Dept.
W. R. Mabey, D. Tse, A. Baraze, and T. Mill.
Chemosphere, Vol 12, No 1, p 3-16, 1983. 2 Fig, 7 Tab, 13 Ref.

Descriptors: *Fate of pollutants, *Photolysis, *Trinitrotoluene, Organic compounds, Rivers, Natural waters, Streams, Light, Water depth, Shallow water, *Nitroaromatics.

The photolysis of 2,4,6-trinitrotoluene (TNT) was studied in aqueous solution to estimate the rates of transformation and transport of munitions chemicals in aquatic systems of interest to the US Army. In applying the findings to the environmental photolysis rate constants for TNT it is noted that although TNT photolyzes more rapidly in natural waters than in pure water it is useful to know the direct photolysis rate constants of TNT in sunlight in pure water as limiting (minimum) rate constants that can be expected in aquatic systems. For direct photolysis rate constants for TNT, it is the rate constant before rate acceleration by products that is relevant to environmental assessments, and thus the reaction quantum yield of .0027 is used for rate constant calculations. The products do accelerate the rate of photolysis, and thus rate constants measured in pure water would be expected to show a dependence on initial TNT concentration and the amount of TNT reacted if the TNT concentration is greater than 1 ppm. Even direct photolysis of TNT is a reasonably rapid process in aquatic systems. Photolysis of TNT in several natural waters is shown to be more rapid than in pure water, and thus TNT will photolyze very rapidly in aquatic systems of shallow depth and low absorbance. While the mechanism for photolysis of TNT is not known, evidence suggests that the photolysis may be occurring via a triplet-excited state. The products from TNT show an exceptional ability to promote TNT photolysis. (Baker-FRC)
W83-04055

CONCENTRATION OF HEAVY METALS IN SEAWATER AND SEDIMENTS FROM THE NORTHERN AEGEAN SEA, GREECE,

Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
K. Fytianos, and G. S. Vasilikiotis.
Chemosphere, Vol 12, No 1, p 83-91, 1983. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Heavy metals, *Marine environment, Lead, Copper, Mercury, Zinc, Cadmium, Manganese, Nickel, Fate of pollutants, Water pollution sources, Aegean Sea, Greece, Thermaikos Gulf, Kavala Gulf.

The distribution of heavy metals was studied in seawater and sediments in areas which face increasing marine pollution problems in the closed gulfs of Thermaikos and Kavala in the north Aegean sea. Compared to other regions of the world, concentrations of heavy metals were higher in these study areas, which may be due to the geological configuration of the Thessaloniki gulf and to the increasing pollution from industrial waste and domestic sewage. Significant seasonal fluctuations of heavy metal concentrations were not found, except for a slight increase in the beginning of winter. This may be due to the rainfalls at this time, which wash off street dust rich in heavy metals, especially lead. Heavy metal concentrations in sediments show that lead existed in only a small portion of the waters, the main portion being combined with suspended elements; however, for zinc the opposite is true. It was concluded that the concentration of the heavy metals in water and sediments is higher than in other regions. The Gulf of Kavala is less polluted than Thermaikos Gulf. The present situation could be improved if the planned chemical and biological treatment for industrial waste and domestic sewage were started immediately. (Baker-FRC)
W83-04056

GROUNDWATER PROTECTION - SUFFICIENT AGAINST THREATS TO PUBLIC WATER SUPPLY DUE TO GROUNDWATER POLLUTION. (GRUNDWASSER-SCHUTZ - AUSTREICHEND ANGESICHTS DER BEDROHUNG DER OFFENTLICHEN WASSERVERSORGUNG DURCH GRUNDWASSERVERUNREINIGUNGEN.),
Bonn Univ. (Germany, F.R.). Inst. fuer das Recht der Wasserwirtschaft.
J. Salzwedel.
Gas- und Wasserfach: Wasser-Abwasser, Vol 123, No 11, p 531-539, 1982.

Descriptors: *Water supply, *Water pollution sources, Halogenated hydrocarbons, Nitrates, Sulfates, Fertilizers, Germany, Leaching, Sewer systems, Legal aspects, Legislation, Regulations, Dumping, Groundwater contamination.

Pollution of water supplies in Germany by halogenated hydrocarbons, nitrates and sulfates continues to be a problem. The State regulations concerning requirements for storing, transferring, and transporting water-polluting substances were an important step toward a better groundwater protection system. Leaching of halogenated hydrocarbons through sewage pipes can only be resolved by introducing adequate inhibitions or restrictions into local drainage through laws or law enforcement of the legal instruments provided in some State Water Acts concerning discharges into sewers. Licenses permitting exceptions for dumping sites in water catchment areas should no longer be granted. Disposal of animal excreta and fertilizers in or close to water catchment areas needs a license under the Federal Water Act. Use of such license makes it possible to enforce a fertilizing scheme which will safeguard the protection of the groundwater against nitrates and sulfates. The restrictions on farming in the interest of public water supply safety do not entitle the farmers to compensation. A farmer who causes damage to a water works by polluting the groundwater is required to compensate for the damage, whether or not it is directly his fault. (Baker-FRC)
W83-04093

1982 STOCKHOLM CONFERENCE ON ACIDIFICATION OF THE ENVIRONMENT,
B. Hileman.
Environmental Science & Technology, Vol 17, No 1, p 15A-18A, January, 1983.

Descriptors: *Fate of pollutants, *Water pollution effects. *Air pollution, *Acid rain, *Conferences, Water pollution sources, Sulfur compounds, Regulations, Oxides, Nitrogen compounds, International agreements.

Recently West Germany and Switzerland took up the position of the Scandinavian countries in viewing acid rain as a problem which should warrant control actions. The problem of forest destruction by acid rain was discussed intensively at the 1982 Stockholm Conference on Acidification of the Environment. The conference consisted of three international meetings. The first was on the ecological effects of acid deposition, and the second was on methods to control sulfur and nitrogen oxide emissions. The third conference was a ministerial meeting of government representatives. The first two expert conferences concluded that forest damage in an estimated one million hectares of Central Europe seems to be related to gaseous pollutants and soil impoverishment, and that trees will not survive beyond 30 to 50 years of age. The United States and Great Britain were the only two countries that contended immediate reductions in sulfur dioxide and nitrogen oxide emissions were not in order until more research is performed. The ministers' conference adopted a consensus statement asserting that further concrete action is needed to control trans-boundary air pollution and called for concerted international programs for the reduction of sulfur emissions. The consensus statement, however, is nonbinding, and did not receive the support of all polluting nations. (Geiger-FRC)
W83-04095

CONTINENTAL-SCALE VARIATIONS IN PRECIPITATION CHEMISTRY,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 2K.
W83-04096

ASBESTOS POLLUTION LEVELS IN RIVER WATER MEASURED BY PROTON-INDUCED X-RAY EMISSION (PIXE) TECHNIQUES,
Montreal Univ. (Quebec). Lab. de Physique Nucleaire.
S. Monaro, S. Landsberger, R. Lecomte, and P. Paradis.
Environmental Pollution, Series B, Vol 5, No 2, p 83-90, 1983. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Asbestos, *Magnesium, *Mine wastes, Fate of pollutants, Water analysis, Quebec, Rivers, Becancour River, X-ray emission techniques.

Asbestos fiber levels were determined by proton-induced X-ray emission (PIXE) at 12 sites in the Becancour River, Quebec, which drains the mining areas of Thetford Mines and Black Lake. Of the 13 elements determined, Mg was most highly correlated with the number of asbestos fibers as determined by transmission electron microscopy. About 1.25 billion fibers per liter correlated with about 250 micrograms Mg per liter; about 5 billion fibers per liter, with 1500 micrograms Mg per liter. Highest Mg concentrations were found within the mining area and reached 2500 micrograms Mg per liter during a rainstorm. The average of dry weather samples reached a maximum of about 800 micrograms Mg per liter. Mg concentrations decreased sharply to 100 micrograms per liter within a few km downstream from the mining area as a result of sedimentation in lakes. (Cassar-FRC)
W83-04097

RELEASE OF POLYCHLORINATED BIPHENYLS FROM CONTAMINATED LAKE SEDIMENTS: FLUX AND APPARENT DIFFUSIVITIES OF FOUR INDIVIDUAL PCBS,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
J. B. Fisher, R. L. Petty, and W. Lick.
Environmental Pollution, Series b, Vol 5, No 2, p 121-132, 1983. 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Desorption, Fate of pollutants, Chlorinated hydrocarbons, Organic compounds, Diffusivity, Waukegan Harbor, Illinois.

The release of polychlorinated biphenyls (PCB) from contaminated Great Lakes sediments to overlying water was studied in the laboratory. Sediments, obtained from Waukegan Harbor, contained (in nmol per g dry sediment): 2,3,5-trichlorobiphenyl, 3.6; 2,2,4,5-tetrachorobiphenyl, 5.7; 2,2,4,5,5-pentachlorobiphenyl, 1.3; and 2,2,3,4,5-pentachlorobiphenyl, 0.59. Fluxes from sediment to water (0.02-1.58 nmol per sq m per day) measured during 4 collection periods (Days 4-12, 12-25, 25-28.9, and 48.9-73.8) were largest during the first period and decreased with time. The most mobile was 2,2,4,5,5-pentachlorobiphenyl, followed in decreasing order by the tetrachloro-; the 2,2,3,4,5-pentachloro-; and the trichlor- compounds. Apparent diffusivities were 1.2-850 times 10 to the minus 9 power sq cm per day. In the absence of disturbance and with low sedimentation rates, PCB in a surface layer will be covered over and removed from access to overlying water within 3 years. (Cassar-FRC)
W83-04098

MERCURY SPECIATION IN WATER,
Alberta Environmental Center, Vegreville.
S. Ramamoorthy, T. C. Cheng, and D. J. Kushner.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 85-89, 1983. 4 Fig, 12 Ref.

Descriptors: *Mercury, *Speciation, *Water, Air, Bacteria, Hydrogen peroxide, Path of pollutants, Fate of pollutants.

Mercury speciation was investigated in water and in the air above water surfaces. The effects of hydrogen peroxide, of bacterial growth medium which contains a number of mercury binding compounds, and of both living and dead bacteria were also tested. Metallic mercury is transported from water into the air by both living and dead bacteria. The amount of total mercury produced in the head space was similar in living or dead bacterial and hydrogen peroxide systems. Hydrogen peroxide stabilized mercury in the system. Partition coefficients were calculated from the corrected concentrations in the head space using literature solubility values for air/water phases. It is possible that metallic mercury could be produced in a microenvironment through biological or abiological pathways, and further movements to air from the water or subsequent transformation of this mercury will depend on the physicochemical conditions of the bulk water. (Baker-FRC)
W83-04105

THE REGIONAL SEAS PROGRAM: WHAT FATE FOR UNEP'S CROWN JEWELS.,
P. Hulm.
Ambio, Vol 12, No 1, p 2-13, 1982. 10 Fig, 25 Ref.

Descriptors: *Water pollution control, Seawater, Atlantic Ocean, Pacific Ocean, Asian Ocean, Caribbean Sea, Red Sea, Gulf of Aden, Kuwait, Mediterranean Sea, Water management, Administration, Planning, International waters, International commissions, International agreements.

An overview is offered of each of UNEP's 10 Regional Seas Programs. In the area of the Mediterranean Sea the main pollution problems in coastal waters are caused by domestic sewage and industrial discharges, the use of pesticides in agriculture, and oil pollution from heavy ship traffic. In the Red Sea and Gulf of Aden problems arise from accidental spills and intentional discharges by ships, oil from land based sources, physical disturbances resulting from dredging, and construction operations. In the Kuwait region, eight of the fastest developing countries in the world cluster around the Gulf, but it gets virtually no rain and hardly any freshwater except through the Shatt al-Arab. Urban growth has outstripped facilities for sewage and garbage disposal. Wastes from booming industrial developments are fast becoming a major concern. The largest single source of marine pollution has been the giant oil tankers. In the

Wider Caribbean area of two of the most important ecosystems are the coral reefs and the mangrove swamps. Coral reefs are menaced by collectors, careless boaters, siltation, and chemical runoff from agricultural pesticides and fertilizers. Mangrove swamps are threatened with deliberate destruction as people build marinas, beaches and hotels. In west and central Africa problems include oil pollution, discharges from developing industries, wastes from inland sources such as sewage, and agricultural runoff. East Asia's most pressing problems are oil pollution from offshore and onshore activities and from tanker traffic, coral reef destruction from blast fishing, destruction of mangrove swamps by fish pond operators and logger, and sewage pollution in shell-fishing areas. Southeast Pacific areas are threatened by mineral pollution, food processing wastes and oil pollution. Southwest Pacific regions are concerned with management of limited resources, both terrestial and marine. East Africa deals with heavy oil tanker traffic and preservation of the mangrove animal life. Southwest Atlantic regions are just getting underway with pollution control studies. (Baker-FRC)
W83-04131

LIMNOLOGY OF LAHONTAN RESERVOIR, 1980-1982,
Nevada Univ. System, Reno. Bioresources Center.
J. J. Cooper, S. C. Vigg, R. W. Bryce, and R. L. Jacobson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105428, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Center, Desert Research Institute Publication No 50020, September 1983. 187 p, 40 Tab, 49 Fig, 170 Ref. OWRT B-117-NEV(1), 14-34-0001-0271.

Descriptors: Water quality management, Water quality, Limnology, *Chlorophyll a, *Nitrogen, *Phosphorus, *Algal toxins, *Eutrophication, Phytoplankton, Zooplankton, Lake sediments, *Nevada, Lahontan Reservoir, Mercury, Arsenic, Lead, Iron.

Based on the level of primary production, chlorophyll a concentration and the dominance of the alga Aphanizomenon flos-aquae, Lahontan Reservoir can be categorized as a eutrophic waterbody. Probably the most important environmental factor contributing to the dominance of this blue-green alga is Lahontan's low N:P ratio. Phosphorus removal from loading is the best technique for eutrophication abatement, and nitrogen removal may be detrimental because it could encourage the growth of nitrogen fixing blue-green algae. The major sources of phosphorus are the Carson River and Truckee canal with the sediments acting as a net phosphorus sink. Bank storage return to the reservoir during low stages may be another source of phosphorus. The measured phosphorus from under water seepage and bank flow are TP up to 12.9 mg/l and OP up to 1.0 mg/l. Mercury in the sediments is a problem because the elevated levels have permitted some transfer to the food chain. At the present time numerous fish species are at or slightly above the recommended Hg levels. Arsenic and lead are also detected in the sediments but do not appear to present a problem at this time. Iron concentrations are high which is expected and probably accounts for most of the phosphorus adsorption.
W83-04144

PHYTOPLANKTON UPTAKE AND SEDIMENT RELEASE OF NITROGEN AND PHOSPHORUS IN THE CHOWAN RIVER, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5C.
W83-04146

POLYCYCLIC AROMATIC HYDROCARBONS-ARE THEY A PROBLEM IN PROCESSED OIL SHALES,
Utah Water Research Lab., Logan.
D. L. Maase, and V. D. Adams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105469, Price codes: A08 in paper copy, A01 in microfiche. Water Quality Series UWRL/Q-83/07, May 1983. 160 p, 16 Fig, 34 Tab, 254 Ref, 3 Append. OWRT B-154-UTAH(2), 14-34-0001-8123.

Descriptors: Oil shale, Hydrocarbons, Chlorination, Wastewater treatment, Carcinogens, Drinking water, *Environmental effects, Organic wastes, Organic carbon, *Polycyclic aromatic hydrocarbons, *Aromatic hydrocarbons, Water treatment.

Development of an oil shale industry could potentially expose spent shales to the natural elements and thereby introduce polycyclic aromatic hydrocarbons (PAH) into the environment where they may enter rivers and lakes and eventually public water supplies. In the first case, harms to the aquatic environment are possible. In the second, chlorine disinfection may convert some of these hydrocarbons into carcinogenic compounds. Analysis of the problem requires assessment of the amount of source material and its fate and potency. In order to estimate the potential PAH flux, a probable development scenario for exposure of processed oil shale in surface disposal sites in the White River Basin of Utah and Colorado was projected along with influential hydrologic and geologic parameters. Processed oil shale samples were obtained from the Union B, Paraho, and Tosco II processes, and samples were extracted by organic solvents in a soxhlet apparatus and by mixing shale samples with water. The organic chemistry literature was used to identify hydrocarbon regimes and classify 3 through 6 ring aromatic hydrocarbons in a tabular format. More than 100 organic compounds from processed oil shales were identified by gas chromatography and mass spectrometry. Four and 5 ring PAH were found to be benzene extractable from processed shales in concentrations ranging up to 50 ppb. Sediment transport or eroded shale is an equally important potential shale source. Chlorine disinfection studies indicate that chlorination does not protect well buffered drinking water supplies from PAH-originating carcinogens. As to the threat to the natural environment, the PAH are believed to gradually degrade to smaller PAH and finally to aliphatic acid. Research on the processes and environmental effects at all stages need to be pursued.
W83-04148

CONCENTRATIONS OF ORGANIC PHOSPHATE, NITROGEN, AND CARBON IN STORM RUNOFF AND COMBINED SEWERS IN THE GREATER WASHINGTON, D.C. AREA,
American Univ., Washington, DC. Dept. of Biology.
M. A. Champ.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105576, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Report No 54, Univ. of the District of Columbia, Washington, D.C., September 1983. 49 p, 6 Fig, 7 Tab, 34 Ref, 1 Append. OWRT A-004-DC(1), 14-31-001-50502.

Descriptors: *Organic phosphate, *Nitrogen, *Dissolved organic carbon, Combined sewer, *Street runoff samples, Shopping center parking lot, Rock Creek, Potomac River, Nutrients, River estuary, *District of Columbia, *Storm sewer runoff.

Concentrations of organic phosphate, nitrogen, and carbon have been determined in storm and combined sewers, sanitary sewers, street runoff, shopping center parking lot runoff, residential and industrial areas, and Rock Creek to determine their range of variation and relative magnitude. Combined sewers exhibit tremendous variation in organic carbon, and nitrogen concentrations. Estimates of the nutrient loads by major sources (storm sewers, combined sewer over flows, etc.) to the upper Potomac River Estuary for 1977 indicate that during a low flow year, combined sewer overflow contributes an insignificant amount of phosphate, nitrogen and carbon. However, during the same period the storm sewer runoff did contribute high loads of carbon and was a minor source of nitrogen.
W83-04159

POLLUTION EFFECTS ON ECOBIOLOGY OF BENTHIC POLYCHAETES IN VISAKHAPATNAM HARBOUR (BAY OF BENGAL),
Andhra Univ., Waltair (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W83-04165

METAL AND BACTERIAL CONTAMINATION IN NEW JERSEY ESTUARINE SEDIMENTS,
Quebec Univ., Rimouski. Dept. of Oceanography.
W. H. Renwick, and H. M. Edenborn.
Environmental Pollution, Series B, Vol 5, No 3, p 175-185, 1983. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Heavy metals, *Coliforms, *Water pollution sources, *Estuaries, *Marine sediments, *Streptococcus, Urban runoff, Metals, Fate of pollutants, Enteric bacteria, Bays, Lagoons, *New Jersey.

Metal and bacterial contamination was examined in sediments of 24 channels of New Jersey lagoons or back bays scheduled for maintenance dredging. Seventy samples were analyzed for texture, total coliforms (TC), fecal coliforms (FC), fecal streptococci (FS), and seven heavy metals. Bacterial analyses revealed TC, FC, and FS concentrations as high as 8334, 3052, and 3052 most probable number units/g dry weight, respectively. Sediment metal levels were moderate compared with those of estuaries in urban areas and were higher in more populated northern areas. Enrichment factors ranged from 1 to 50 times probable background levels. TC and metal levels were negatively correlated with percentage of sand in the samples. FC and FS were poorly correlated with texture, suggesting localized sources for these bacteria. The intercorrelations of metal levels suggested discrete and common sources for these contaminants. TC and metal levels were highest in densely populated areas, suggesting that urban runoff may be a major pollution source. The concentrations of pollutants in the heavily contaminated areas are high enough to warrant additional studies prior to dredging and soil disposal. (Geiger-FRC)
W83-04171

HEAVY METALS IN THE SEDIMENTS OF COCKBURN SOUND, WESTERN AUSTRALIA, AND ITS SURROUNDING AREAS,
Envirochem, Perth (Australia).
V. Talbot, and A. Chegwidden.
Environmental Pollution, Series B, Vol 5, No 3, p 187-205, 1983. 1 Fig, 2 Tab, 34 Ref.

Descriptors: *Heavy metals, *Water pollution sources, *Fate of pollutants, *Marine sediments, *Cadmium, *Indicators, Industrial wastes, Metals, Hydrogen ion concentration, Conductivity, Chromium, Lead, Cockburn Sound, *Australia.

The extensive industrial development of Western Australia near Cockburn Sound has prompted studies of some physical properties (conductivity and pH), heavy metal levels, and organic and carbonate levels of the calcareous marine sediments of this area. Regional and local surveys and core and surface sediment samplings showed no evidence of the widespread cadmium (Cd) pollution that is known to exist in the biota due to discharges of Cd-contaminated gypsum. However, lead was concentrated in the carbonate sediments, and chromium (Cr) from tannery wastes was also found. Although the concentrations of metals in sediments correlated significantly with the anthropogenic activities around the Sound, the overall use of marine calcareous sediments as indicators of heavy metal pollution is not recommended when oxidizing conditions prevail. (Geiger-FRC)
W83-04173

THE DEPAUPERATION OF EPIFAUNA ON PINNA BICOLOR NEAR A LEAD SMELTER, SPENCER GULF, SOUTH AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Cronulla (Australia). Div. of Fisheries Research.
For primary bibliographic entry see Field 5C.
W83-04174

CONTINUED STUDIES OF ACID RAIN AND ITS EFFECTS ON THE BATON ROUGE AREA,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
J. W. Robinson, and H. Ghane.
Journal of Environmental Science and Health, Part A, Vol 18, No 2, p 165-174, 1983. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Baton Rouge, *Louisiana, *Dissolved oxygen, *Hydrogen ion concentration, *Acid rain, *Lakes, Water pollution effects, Fate of pollutants, Acidic water, Ecological effects, Water pollution sources, Monitoring, Path of pollutants.

In an ongoing project to study the effects of acid rain in the Baton Rouge area, two lakes were monitored for dissolved oxygen, pH, and buffering capacity before and after rainfall from 1981 to 1982. The smaller of the two lakes revealed higher pH than the larger and exhibited a higher buffering capacity. The pH of the lakes was lower in 1982 compared to 1981, and dissolved oxygen levels increased after rainfalls. The effects of dredging of the larger lake on parameters studied were inconclusive. Although a pH of less than 5 is generally undesirable for aquatic life, the sensitivity of this threshold value depends on such factors as watershed size and amount of precipitation. Due to the relatively large watershed and high total acid deposition in the Baton Rouge area, these lakes are susceptible to reductions in buffering capacity which would be undesirable to aquatic life. Future monitoring programs of this problem will include data collections on pH, wind direction, dissolved oxygen levels, and major anions and cations in rain water. (Geiger-FRC)
W83-04186

A NOTE ON THE GROWTH OF THIOTHRIX IN ROAD DRAINAGE DITCHES,
Freshwater Biological Association, Ambleside (England).
J. G. Jones, F. M. S. Jay, and J. Hilton.
Journal of Applied Bacteriology, Vol 53, No 3, p 427-430, 1982. 1 Fig, 3 Tab, 5 Ref.

Descriptors: *Thiobacillus, Road construction, *Fate of pollutants, Water pollution sources, Drainage effects, *Sulfur, *Bacterial analysis, *Lake sediments, Drainage ditches, Water pollution effects, Sulfides, Hydrogen ion concentration, Path of pollutants, Bioindicators, Limestone, *England, Bassenthwaite Lake.

Macroscopic growth of Thiothrix has been noted in ditches draining new sections of the A66 road along the Bassenthwaite Lake of the English Lake District. Furnace slag and limestone had been used as hard core during road construction. The growth of Thiothrix resembled the sewage complex found in polluted rivers. Of the eight ditch sites studied, Thiothrix was not observed in two, possibly due to high sulfide levels of pH and total ions in one ditch and low oxygen levels and high conductivity and pH in the other. Studies to determine the effects of ditch contamination on the lake revealed little evidence of adverse effects. Enrichment by sulfur was confined to sites closest to the mouth of Wythop Beck, and bacteria which usually develop in sulfide-rich sediments were not detected. The development of Thiothrix populations may serve as a useful indicator of sulfide contamination and contribute to the detoxification of the drainage water without imposing a significant oxygen demand. (Geiger-FRC)
W83-04199

5C. Effects Of Pollution

HEPATIC METALLOTHIONEIN IN RAINBOW TROUT (SALMO GAIRDNERI) AS AN INDICATOR OF METAL POLLUTION IN THE CAMPBELL RIVER SYSTEM,
Victoria Univ. (British Columbia). Dept. of Biochemistry and Microbiology.
M. Roch, J. A. McCarter, A. T. Matheson, M. J. R. Clark, and R. W. Olafson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 12, p 1596-1601, December, 1982. 3 Fig, 3 Tab, 23 Ref.

Descriptors: Fish, *Accumulation, Metals, *Metallothionein, Proteins, Pollutant identification, Bioaccumulation, Fate of pollutants, Campbell River, *British Columbia, Trout, Zinc, Copper, Cadmium, *Heavy metals, Mine wastes, *Rainbow trout.

Levels of hepatic metallothionein in rainbow trout livers reflected the exposure of the fish to heavy metals in the Campbell River system, British Columbia, which is contaminated with zinc and other metals derived from mine tailings. Concentrations of metals in water samples were of the order Zn>Cu>Cd; in fish livers, Cu>Zn>Cd. Highest metals concentrations in fish livers were found in South Buttle Lake, nearest the mine: 539 + or - 124 micrograms per g Cu; 168 + or - 50 micrograms per g Zn; and 19.4 + or - 6.1 micrograms per g Cd. Metallothionein concentrations increased from 58 + or - 14 nmol per g in livers from fish taken in an unpolluted lake to 269 + or - 23 nmol per g in livers from fish taken from the most heavily contaminated site, South Buttle Lake. (Cassar-FRC)
W83-03854

A STUDY ON THE EVALUATION OF WATER QUALITY WITH RESPECT TO BORON FOR WHEAT AND BARLEY GROWTH ON LOAMY SAND SOIL,
S.K.N. Coll. of Agriculture, Jobner (India).
F. Lal, and P. Lal.
Annals of Arid Zone, Vol 19, No 3, p 239-241, September, 1980. 2 Tab, 8 Ref.

Descriptors: *Boron, *Irrigation water, *Crop yield, Water pollution effects, Toxicity, Wheat, Barley, Water quality.

Wheat and barley were grown on alkaline loamy sand soils on an experimental farm in India using irrigation waters with boron levels of 0.7, 1.7, 2.7, 4.7, 6.7, and 8.7 ppm, pH of 8.8, electric conductivity of 2.1 mmhos per cm, sodium absorption ratio of 23.7, and residual sodium carbonate of 14.2 meq per liter. The soil was low in boron. Grain and straw yields of wheat increased significantly up to 1.7 ppm boron in water and gradually decreased thereafter. At 8.7 ppm boron the wheat yield was reduced by 30% of the maximum yield. Data on barley were similar, except that the maximum yields were obtained at a boron concentration of 2.7 ppm. Apparently the accumulated boron was leached out by successive irrigations in this soil, permitting crops to be grown safely at boron concentrations higher than the usually accepted 2 ppm. (Cassar-FRC)
W83-03870

THE INFLUENCE OF PREVIOUS LIGHT HISTORY ON THE RESPIRATION OF FOUR SPECIES OF FRESHWATER PHYTOPLANKTON,
Adelaide Univ. (Australia). Dept. of Botany.
S. Stone, and G. Ganf.
Archiv fur Hydrobiologie, Vol 91, No 4, p 435-462, July, 1981. 12 Fig, 3 Tab, 44 Ref.

Descriptors: *Light intensity, *Phytoplankton, *Respiration, *Irradiation, *Euthrophication, Euphotic zone, Regression analysis, Cyanophyta, Photosynthesis, Chlorophyta, Oxygen requirements, Oxygen uptake, Radiation, Hysteresis, Model studies, Mathematical studies, Light penetration.

The separate effects of light intensity and duration on the respiration of Microcystis aeruginosa, Anabaena cylindrica, Secenedesmus quadricauda and Pedisastrum boryanum were investigated by an oxygen electrode technique. As light intensity increased, all species showed a general increase in respiration Secenedesmus, Pediastrum and Anabaena exhibited a strong correlation between respiration and photosynthetic rate, while Micorocystic had respriatory rates which increased at irradiances above photosynthetic light saturation. After prolonged illumination, rates of dark respiration were increased for up to 14 hr. The initial decline in respiration was decribed by a negative exponential function. Regression analysis utilizing the respiratory coefficient was used to estimate the critical downward velocity throught the euphotic zone needed to elicit a hysteresis effect. Due to their greater critical downward velocity, green algae seemed better adapted to rapid circulation than blue-green algae. Dark respiration rates were greatest in Anabaena and Microcystis. This was attributed to their ability to maintain their position in the euphotic zone, which reduced their need to conserve photosythate. (Geiger-FRC)
W83-03874

CARBON-14 ASSIMILATION BY ALGAL COMMUNITIES OF OLIGOTHROPHIC PONDS TREATED WITH FORMULATED AMINOCARB,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
J. K. Elner, D. J. Wildish, and D. W. Johnston.
Archives of Environmental Contamination and Toxicology, Vol 11, No 6, p 675-679, November, 1982. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Pesticides, *Algae, *Toxicity, Aminocarb, Matacil, Oligothrophic lakes, Water pollution effects, Ponds, Inhibition, *New Brunswick.

The effects of an animocarb formulation (Matacil 1.8D) on algal communities were studied in a natural pond in New Brunswick. The insecticide, used in forests for controlling spruce budworm, was composed of 21.7% aminocarb, 51.2% nonly phenol (formerly found capable of cellular disruption in flagellates), and 17.1% No. 585 oil. Carbon-14 assimilation was used to measure algal production. Unsolubilized Matacil at a concentration of 1454.4 ppm aminocarb reduced carbon uptake to 24.5% of its original value after 5 hours of incubation. During a 28-hour carbon uptake was reduced to 20% of the initial value at 1.45-14.5 ppm aminocarb and to about 7% at 1454.4 ppm. Using ethanol-solubilized Matacil to increase solubility, carbon assimilation was virtually stopped at 1-2 ppm for both incubation periods. EC50 values were 0.88 ppm and 0.56 ppm for the 5 and 28-hour incubation periods, respectively. In another experiment in EC50 of 0.94 ppm of solubilized Matacil was obtained in a 4-hour incubation; all algal carbon assimilation had ceased by 1.54 ppm. At insecticide concentrations up to 2.24 ppm aminocarb or less, algal production recovered within 72 hours. Maximum aminocarb levels in water affected by forest spraying are 0.02 ppm. Although all insecticide levels were reported as ppm aminocarb, other components of the formulation may also affect toxicity. (Cassar-FRC)
W83-03876

EFFECTS OF THE WATER-SOLUBLE FRACTION OF A COAL-DERIVED OIL ON POND MICROCOSMS,
Oak Ridge National Lab., TN.
J. M. Giddings.
Archives of Environmental Contamination and Toxicology, Vol 11, No 6, p 735-747, November, 1982. 12 Fig, 4 Tab, 22 Ref.

Descriptors: *Coal liquefaction, *Oil wastes, *Aquatic life, *Water pollution effects, Ecosystems, Algae, Macrophytes, Aquatic plants, Snails, Zooplankton, Diatoms, Toxicity, Water quality, Species composition, Synthetic fuels, Phytoplankton.

The effects of a solution of the water-soluble fraction (98% phenols by weight) of a crude coal liquefaction product on 80-liter pond microcosms were studied for 9 weeks. The oil, produced by the Solvent Refined Coal-II Process in a pilot plant, was a blend of middle and heavy distillates. The 1% dose applied to the aquariums was close to the 48-hour LC50 for Daphnia magna and for photosynthetic inhibition of algae. In the first 5 days after treatment much of the Elodea turned brown, Nitella survived, and Spirogyra turned pale and sank. Snails crawled out of the tank. Zooplankton became scarce. Primary production and respiration declined for two weeks, remained low for two

more weeks, and gradually returned to pretreatment levels. Changes occurred in pH, alkalinity, conductivity, dissolved oxygen, dissolved organic carbon, and dissolved inorganic nitrogen. After several weeks of nearly anaerobic conditions the ecosystems started to recover. By the end of the experiment the communities were different in composition. Spirogyra had not returned, and Nitella had increased in abundance. A small unidentified cladercoceran replaced Simocephalus as the major zooplankton species. Ostracods and oligochaetes increased in numbers. Community compositions of benthic algae were radically changed by the treatment and were different in the two replicates. At the end of the experiment snail biomass and macrophyte biomass averaged 66% and 28%, respectively, of that in controls. (Cassar-FRC)
W83-03877

COMPARISON OF ESTUARINE SPECIES SENSITIVITIES TO THREE TOXICANTS,
William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
M. H. Roberts, J. E. Warinner, Jr., C.-F. Tsai, D. Wright, and L. E. Cronin.
Archives of Environmental Contamination and Toxicology, Vol 11, No 6, p 681-692, November, 1982. 6 Fig, 4 Tab, 34 Ref.

Descriptors: *Toxicity, *Phytoplankton, Aquatic animals, *Bioindicators, *Water pollution effects, Estuarine environment, Sodium lauryl sulfate, Detergents, Cadmium, Lannate, Methomyl, Insecticides, Pesticides, Copepods, Invertebrates, Fish, Algae, Shrimp.

Tests were conducted to compare the sensitivity of EPA standard species with that of species more representative of the Chesapeake Bay. The acute toxic effects of sodium lauryl sulfate (SLS), cadmium, and Lannate (24% methomyl in ethanol) were tested on species pairs, which included phytoplankton (Prorocentrum minimum, Pseudoisochrysis paradoxa, Skeletonema costatum); mysid shrimp (Neomysis americana and Mysodopsis bahia); copepods (Eurytemora affinis and Acartia tonsa); and fish (Menidia menidia and Cyprinodon variegatus). The EC50s (mg per liter) for phytoplankton were: SLS, 1.27-2.33; cadmium, 12-681; and Lannate, 388-580. The 96 hour LC50s (mg per liter) for the animals were: mysids, 5.7-8.8 for SLS, 0.017-0.036 for Cd, and 0.030-0.064 for Lannate; copepods, 0.55-2.6 for SL, 0.06-0.38 for Cd, and 0.29-0.41 for Lannate; fish, 2.8-4.1 fo SLS, 6.4-15.9 for Cd, and 0.34-0.96 for Lannate. All EC and LC50s within a species group were similar except for phytoplankton response to Cd. (Cassar-FRC)
W83-03878

PLANKTON OF THE LOWER RIVER MURRAY, SOUTH AUSTRALIA,
Adelaide Univ. (Australia). Dept. of Zoology.
R. J. Shiel, K. F. Walker, and W. D. Williams.
Australian Journal of Marine and Freshwater Research, Vol 33, No 2, p 301-327, 1982. 11 Fig, 3 Tab, 57 Ref.

Descriptors: *Seasonal variation, *Zooplankton, *Phytoplankton, Murray River, Darling River, *Australia, Plankton, Algae, Diatoms, Cyanophyta, Species composition, Rivers, Semiarid lands, Eutrophication, Rotifers, Regulated flow, Littoral zone, Temperature effects, Salinity, Turbidity.

Seasonal variations in plankton composition of the Murray River, Australia, were investigated during 1976-77. Flows in the 2500 km long Murray were variable, exceptionally slow, and regulated by many weirs and reservoirs. Its major tributary, the 2700 km Darling River, has a small, variable flow, is relatively unregulated, and has a deeply incised floodplain. The Darling enters the Murray about 500 km upstream from the sea. Murray waters carry blooms of Cyanobacteria (Anabaena and Anacystis spp.) in summer and diatoms (Melosira and Cyclotella spp.) in winter and spring. Murray zooplankton comprised 133 taxa: 87 Rotifera, 31 Cladocera, 13 Copepoda, and 2 Ostracoda. More than half were pseudoplanktonic or from the littoral zone. More than half were endemic. Most were derived from upstream reservoirs. Mean zooplankton density at a station 150 km from the Murray mouth measured 119 individuals per liter. Most species were indicative of eutrophic conditions. Darling waters had high turbidity, low algal biomass, and zooplankton dominated by rotifers of the warm stenothermal pantropical type. The composition of the lower Murray plankton depended on the flow contributions of the 2 rivers. Darling contributions were indentifiable by the tropical plankton. Temperature, salinity, and turbidity also affected the lower river species composition. (Cassar-FRC)
W83-03892

ASSESSMENT OF ACIDITY OF LAKES AND PRECIPITATION IN THE SIERRA NEVADA,
California Univ., Santa Barbara. Marine Science Inst.
For primary bibliographic entry see Field 5B.
W83-03911

SURVIVAL AND GROWTH OF WARMWATER FISHES EXPOSED TO AMMONIA UNDER LOW FLOW CONDITIONS,
J. P. Swigert, and A. Spacie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-257535, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 157, June 1983. 83 p, 3 Fig, 13 Tab, 33 Ref, 1 Append. OWRT B-115-IND(1).

Descriptors: *Fish, *Toxicity, *Ammonia, Growth, Survival, Fathead minnows, *Indiana, Low flow, Ammonium chloride, Water pollution effects, *Dissolved oxygen, Lethal limit.

The acute toxicity of ammonium chloride was measured for eight fish species representing four families commonly found in midwestern streams. A positive linear relationship was found between the 96-hour median lethal concentrations (LC50) for low dissolved oxygen, and the ambient concentration of ammonia in 96-hour exposures with fathead minnows. Proportional mortality could be described as a linear function of dissolved oxygen concentration and on interaction term between oxygen and ammonia. The results were also shown to follow a concentration-addition model for joint toxic action when ammonia and oxygen concentrations were expressed as 'toxic units'. For 16 families occurring in midwestern non-salmonid waters, a value of 0.2 mg NH sub 3-N/1 was obtained as the criterion maximum (concentration not to be exceeded). The maximum allowable 30-day average concentration was found to be 0.04 mg NH sub 3-N/1. Allowable discharge rates based on 30-day average conditions are more restrictive than discharges based on a one-day maximum allowable concentration for 11 Indiana streams examined.
W83-03923

LETHAL AND SUBLETHAL EXPOSURE AND RECOVERY EFFECTS OF OZONE-PRODUCED OXIDANTS ON ADULT WHITE PERCH (MORONE AMERICANA GMELIN),
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
L. B. Richardson, D. T. Burton, R. M. Block, and A. M. Stavola.
Water Research, Vol 17, No 2, p 205-203, February, 1983. 4 Fig, 1 Tab, 43 Ref.

Descriptors: *Ozonation, *Toxicity, *Sublethal effects, Fish Toxins, Perch, Ozone, Tissue analysis, Gills, Water treatment, Oxidation-reduction potential, Fish, Laboratory studies, Water pollution effects.

Adult white perch (Morone americana), acclimated to 15C, were exposed to a series of ozone-produced oxidants (OPO) concentrations for 96 hours using continuous flow bioassay techniques. Blood pH, hematocrit, and gill histopathology were analyzed in perch exposed to a series of near-lethal and sublethal OPO concentrations at 24, 48, and 96 hours and after 4 and 14 days in the recovery period, which they spent in clean, non-ozonated water. The 24-, 48-, and 96-hour LC-50's were 0.38, 0.26, and 0.20 milligrams OPO per liter, respectively. Significant reductions of blood pH occurred at concentrations of at least 0.15 milligrams OPO per liter, but not at 0.10 milligrams OPO per liter or lower. Hematocrit significantly increased at concentrations of 0.10 milligrams OPO per liter or greater. OPO concentrations of 0.01 milligrams per liter had minimal effects on gill tissue, while moderate epithelial sloughing and heavy mucus production occurred at 0.05 milligrams OPO per liter, and extreme tissue damage was found at concentrations of at least 0.10 milligrams OPO per liter. These results demonstrate the OPO causes death by destroying the gill tissue and thus the respiratory and osmoregulatory capabilities of a fish, eventually causing death through internal hypoxia. When blood pH has been reduced by more than about 0.3 units, gill tissue damage is too extensive for recovery and the fish will eventually die. If gill damage is moderate, white perch gill epithelium can repair itself within 4 days. Comparison of these test results with previous reports of the effects of chlorine produced oxidants shows that the toxicities of these oxidants to adult white perch are about equal when tested under similar conditions and that both have similar effects on gill tissue. (Carroll-FRC)
W83-03932

RE-USE OF SLUDGES AND TREATED WASTE WATER IN AGRICULTURE. (TROUBLES ARISING FROM THE CONTAMINATION OF SOILS WITH HEAVY METALS AND FROM APPLICATION OF SLUDGES AND TREATED WASTE WATER IN AGRICULTURE),
Biologische Bundesanstalt fuer Land- und Forstwirtschaft, Berlin (Germany, F.R.). Inst. for Non-Parasitic Plant Diseases.
For primary bibliographic entry see Field 5E.
W83-03970

HEALTH RISKS ASSOCIATED WITH WATER RECYCLING,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 3C.
W83-03971

PLANT AND SOIL REACTIONS TO NICKEL ORE PROCESSED TAILINGS,
Oregon State Univ., Corvallis. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W83-03976

RELATIONSHIP BETWEEN DRINKING WATER QUALITY AND DEATH FROM CARDIOVASUCLAR DISEASE. III. ASSOCIATION BETWEEN HARDNESS AND CHEMICAL CONSTITUENTS OF DRINKING WATER (CORRELAZIONE EPIDEMIOLOGICA TRA QUALITA' DELLE ACQUE POTABILIE MORTALITA' PER MALATTIE DEL SISTEMA CIRCOLATORIO. III. RAPPORTO TRA DUREZZA E I DIFFERENTI COMPONENTI DELLE ACQUE CONDOTTATE),
Perugia Univ. (Italy). Cattedra di Igiene.
G. Scassellati Sforzolini, P. Damiani, R. Pasquini, R. Conti, and G. Burini.
L'Igiene Moderna, Vol 76, No 6, p 1190-1200, December, 1981. 2 Tab, 25 Ref.

Descriptors: *Water analysis, Chemical properties, *Human diseases, Cardiovascular disease, Hardness, Minerals, Chemical composition, Epidemiology, *Public health, *Italy.

The possible association between hardness and different chemical constituents of tap waters was investigated. For 90 groundwater samples from various areas of the Italian Region of Unbria with degrees of hardness varying from 2.3 to 64.2 degrees fr, the total noncarbonate and carbonate hardness, chloride and sulfate levels as well as the concentrations of 16 important cations were determined. Total hardness was correlated positively and fairly strongly with Ca, Mg, Na, Ag, Hg, Pb, Cd, Mn, Cr, Co, Cl(-) and So4(2-) content and carbonate hardness and negatively, but rather weakly, with K, Li, and Fe. Carbonate hardness

and negatively, but rather weakly, with K, Li, and Fe. Carbonate hardness correlated positively and fairly strongly with Ca, Mg, Na, Cu, Ag, Hg, Pb, Cd, Mn, and Co content and negatively, but rather weakly, with K, Li, Cr, and Fe. Non-carbonate hardness, sulfate concentration and chloride ion concentration correlated positively and fairly strongly with Ca, Mg, Ag, Cd, Mn, and Co and negatively but weakly with K and Fe. These results are discussed on the basis of the epidemiological correlations observed by different authors between hardness and trace elements in drinking waters and mortality from cardiovascular disease. (Baker-FRC)
W83-04022

ENVIRONMENTAL EFFECTS ON THE TOXICITY OF METHYL MERCURIC CHLORIDE TO CHLORELLA VULGARIS,
North-Eastern Hill Univ., Shillong (India). Dept. of Botany.
L. C. Rai, and R. Dey.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 4, p 319-327, 1980. 6 Fig, 22 Ref.

Descriptors: *Methyl mercuric chloride, *Algae, *Toxicity, Water pollution effects *Chlorella, Chlorophyll, Growth rates, Survival, Phosphates, Hydrogen ion concentration, Heavy metals, Metals, Calcium, Sublethal effects.

The effect of methyl mercuric chloride (0.01, 0.001, and 0.0001 ppm) on survival, growth, and chlorophyll content of Chlorella vulgaris was studied under varying conditions of pH (4-10) and phosphate and Ca concentrations (5-40 ppm). Chlorella survival for 15 days at different concentrations of methyl mercuric chloride was zero at 0.01 ppm, about 5% at 0.001 ppm, and 53.8% at 0.0001 ppm (the sublethal dose). Growth rates at 0.001 and 0.0001 ppm were nearly that of the control for the first 9 days. Optical densities of the cultures at 15 days were: control, 1.45; 0.0001 ppm, 1.4; and 0.001 ppm, 1.0. Chlorophyll a was more greatly inhibited than chlorophyll b at the sublethal dose. At the sublethal dose growth was maximum at pH 7-8, less at pH 5-6 and 9-10, and greatly inhibited at pH 4. Methyl mercuric chloride toxicity was greatly reduced by addition of phosphate, with maximum growth stimulation at 20 ppm phosphate, and by addition of Ca at levels of 5-20 ppm. (Cassar-FRC)
W83-04049

TOXICITY OF PH, HEAVY METALS AND BISULFITE TO A FRESHWATER GREEN ALGA,
Waterloo Univ. (Ontario). Dept. of Biology.
M. D. Baker, C. I. Mayfield, W. E. Inniss, and P. T. S. Wong.
Chemosphere, Vol 12, No 1, p 35-44, 1983. 4 Fig, 35 Ref.

Descriptors: *Algae, *Organic compounds, *Heavy metals, Water pollution effects, Environmental effects, Mercury, Acidity, Lead, *Bisulfite, Algal growth, Chlorophyta, Ankistrodemus, *Toxicity.

The toxicity of mercury and bisulfite to the organisms of Ankistrodesmus sp. was studied under acidic conditions. The effect of pH was determined by adjusting the pH of Bristol's medium to initial values of 3, 4, 5, 6, and 7 by adding 9.5 or 1 N sulfuric acid and 0.5 or 1 N sodium hydroxide. No growth occurred at pH 3. A lag phase of about 4 days was noted at pH 4 before the onset of growth, while a 2-day lag period was noted at pH 5. No apparent lag phase was noted at pH 6 and 7 and, generally, growth at pH values of 5, 6, and 7 was similar until after about 10 days, wherein growth was slightly higher at pH 6. When the effect of pH and bisulfite on the growth of the alga was examined, bisulfite concentrations of 1, 10, and 100 microg/ml did not affect growth at pH 7. However, at bisulfite concentrations of 100 microg/ml growth was almost completely prevented at pH 5. Lead at concentrations of 1, 5, and 10 microg/ml had only slight inhibitory effects on growth at pH 5 and 7. Mercury was much more toxic to algal growth, especially at pH 5. Mercury concentrations of 1, 5, and 10 microg/ml inhibited algal growth by 81, 100, and 100%, respectively, while at pH 7 the corresponding values were 57, 77, and 100%, respectively. These findings clearly indicate that the algal cells were more sensitive to bisulfite and mercury at low pH. It is concluded that these toxic compounds could also inhibit algal growth and activity in acidic aquatic systems. (Baker-FRC)
W83-04054

A THRESHOLD CONCEPT OF ENVIRONMENTAL POLLUTANTS,
Institute of Hygiene, Gera (German, D.R.). Dept. of Toxicology.
R. Koch.
Chemosphere, Vol 12, No 1, p 17-21, 1983. 1 Tab, 10 Ref.

Descriptors: Water pollution effects, *Toxicity, Chemical reactions, Environmental effects, Public health, Mutagenesis, Carcinogenesis, Teratogenesis, Classification.

At present, toxicological data such as the acute toxicity, toxicokinetics, toxicodynamics in subchronic exposure, carcinogenicity, mutagenicity, and teratogenicity are basic elements in thresholds concepts. However, biochemical and animal experimentations needed to obtain the data are limited for several reasons. Theoretical considerations are needed for establishing a generally usable threshold concept. It is important to distinguish exactly between the terms dose or concentration and exposure as well as to define the meaning of the term 'threshold'. While relationships between structure, physicochemical properties and chemical reactivity as well as biological activity are well known in molecular toxicology, it is important to note that a chemical reaction between an exogenous compound and a biological macromolecule in target tissue, organs or cells is a fundamental aspect of many biological activities and toxicity reactions. The kinetic, thermodynamic and structure-activity relationships imply that a threshold level exists, depending on different chemical structure parameters which govern absorption, distribution, bioconcentration and excretion processes; and the activation energy of a biochemical reaction and the temperature, which govern both the number of reactive molecules and the reaction rates. The application of thermodynamic, kinetic and quantum mechanic regularities as well as structure-activity relationships suggests that the single molecule causing biological effect is an unacceptable concept. (Baker-FRC)
W83-04057

ORGANOHALOGENES AS CARCINOGENS IN DRINKING WATER (ORGANOHALOGENE ALS KARZINOGENE IM TRINKWASSER),
Institute of Hygiene, Gera (German, D.R.).
R. Koch, and K. Strobel.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 407-420, May, 1980. 1 Fig, 3 Tab, 53 Ref. (No English Summary).

Descriptors: *Halogens, *Drinking water, *Carcinogens, *Literature review, *Risks, Cancer, Epidemiology, Public health, Animal experiments, Organic compounds, Water pollution, Water pollution effects, Population exposure, Pollutants, Water pollution sources, Classification, Reviews.

The current state of knowledge concerning the relationship between cancer incidence and organohalogen pollution of drinking water is presented by means of a literature review of investigations of the levels of halogens in drinking water, classification systems for aquatic carcinogens, epidemiological studies and animal experiments. Although numerous organic compounds, including halogen derivation have been identified as carcinogens in animal and in vitro studies, uniform or comparable methods of study have been used in only a few cases. While carcinogenic or suspected carcinogenic halogen derivatives have been found in concentrations of micro- or submicrograms in drinking water, chronological and geographical differences in degree of pollution have made quantitative statements as to the level and significance of human exposure extremely difficult. The number of epidemiological studies (both those that deal with a possible relationship between cancer and drinking water quality in general and those that focus on specific carcinogens) is too small to prove a relationship between halogens and cancer. Risk cannot be established because human exposure to halogens in drinking water is variable and unquantifiable; a combination of carcinogenic compounds in varying amounts exists in drinking water, whereas animal experiments have dealt with single compounds; a latency time of 5-40 yr before the appearance of cancers makes it difficult to assess present water pollution; many compounds have not yet been tested for carcinogenicity; and drinking water is not only carrcinogens to the human population. However, the studies reviewed do lead to the conclusion that organohalogens pose a potential cancer risk. (Gish-FRC)
W83-04064

IDENTIFICATION AND MUTAGENIC PROPERTIES OF SOME CHLORINATED ALIPHATIC COMPOUNDS IN THE SPENT LIQUOR FROM KRAFT PULP CHLORINATION,
Svenska Traeforskningsinstitutet, Stockholm.
For primary bibliographic entry see Field 5A.
W83-04094

1982 STOCKHOLM CONFERENCE ON ACIDIFICATION OF THE ENVIRONMENT,
For primary bibliographic entry see Field 5B.
W83-04095

ZOOPLANKTON DIVERSITY AND BIOMASS IN RECENTLY ACIDIFIED LAKES,
Ithaca Coll., NY. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W83-04103

RELATIONSHIP BETWEEN BODY-LEAD CONCENTRATION OF MYSIS RELICTA AND SEDIMENT-LEAD CONCENTRATION IN KOOTENAY LAKE, B.C.,
Trent Univ., Peterborough (Ontario).
R. D. Evans, and D. C. Lasenby.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 78-81, 1983. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Lead, *Lake sediments, *Aquatic biota, Mysis relicta, Sediment, Kootenay Lake, Canada, British Columbia, Effects of pollution, Heavy metals.

The relationship between sediment-lead concentration and organism-lead concentration is examined. If migrating benthic organisms are acting as metal pumps to return lead to the pelagic region from the sediments, one would predict a positive correlation between sediment-lead concentration and organism-lead concentration. Mysids collected at two different times during the summer at each station were analyzed for lead concentration. The differences in lead concentration for aparticular site ranged between 1 and 18%. The differences between stations in lead concentration were much greater. Average whole body concentrations ranged from 1.5 to 15 micrograms/g. In Kootenay Lake the lead concentration of the surficial sediments varied from 35 to 750 micrograms/g at the stations at which Mysis were collected. Water flow pattern in the lake was such that any movement of mysids would be from either the north or south end to the middle of the lake and ultimately out through the west arm. As a result of the unique spatial variation in sediment-lead concentration and water movement, it is unlikely that mysids ever move from areas of high contamination in the middle of the lake to areas of low contamintion at the north or south ends. A strong correlation was found between sediment-lead concentration and Mysis-lead concentration, which may indicate that Mysis can accumulate lead from the sediment and return it to the open water. (Baker-FRC)
W83-04104

TOTAL DISSOLVED SOLIDS AS A PREDICTOR OF LAKE BIOMASS AND PRODUCTIVITY,

Alberta Univ., Edmonton. Dept. of Zoology.
E. E. Prepas.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 92-95, 1983. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Lakes, *Productivity, Dissolved solids, Biomass, Chlorophyll, Nutrients, Morphoedaphic index.

Data were collected from 25 lakes located over a large region in central Alberta, in the drainage basins of three major river systems. The mean depth ranged from 2.4 to 19 m, summer epilimnetic total dissolved solids from 128 to 145 mg/liter, and average summer chlorophyll a collected from the trophogenic zone from 1.7 to 150 mg/cubic meter. No relationship was noted between TDS and chlorophyll in these lakes. Also no relationship was noted between mean summer epilimnetic TDS and TP, whereas TP and chlorophyll a were highly correlated. Thus TDS was not a good predictor of phytoplankton biomass as measured by chlorophyll a in these lakes. It was demonstrated that the mean depth was as good as predictor of fish production as the total dissolved solids:mean depth ratio, or the morphoedaphic index. (Baker-FRC)
W83-04106

LOW PH AND THE ABSENCE OF FISH SPECIES IN NATURALLY ACIDIC WISCONSIN LAKES: INFERENCES FOR CULTURAL ACIDIFICATION,
Wisconsin Univ.-Madison. Leb. of Limnology.
F. J. Rahel, and J. J. Magnuson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 3-9, 1983. 2 Fig, 3 Tab, 31 Ref.

Descriptors: *Acidic water, *Fish populations, Acid precipitation, Wisconsin, Lakes, Fish, Acidity.

Fish assemblages were examined in 138 northern Wisconsin lakes, many of which are naturally acidic. The pH range for these waters was 4.0 to 9.2. Differences were evident in the occurrence of species in relation to pH. Darters and most cyprinids were absent below pH 6.2, whereas black bullheads, yellow perch and several centrarchids occurred below pH 5.0. The central mudminnow occurred at the lowest pH, inhabiting bog drainage channels. In comparisons then made with long term laboratory bioassays, field manipulations of pH, and species disappearances in lakes affected by acid precipitation it was determined that species distributions in naturally acidic lakes generally agree with limits determined from these other studies. Discrepancies which occurred were generally minor, involving only a few tenths of a pH unit, or cold be explained by consideration of a species' autoecology. The data collected allow predictions of the relative acid sensitivity of many common fish species, and indicate the species assemblages typical of low-alkalinity, midwestern lakes vulnerable to acid precipitation. (Baker-FRC)
W83-04108

HISTORIC CHANGES IN AN URBAN WATERSHED DETERMINED BY POLLEN AND GEOCHEMICAL ANALYSES OF LAKE SEDIMENT,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
R. W. Mathewes, and J. M. D'Auria.
Canadian Journal of Earth Sciences, Vol 19, No 11, p 2114-2125, 1982. 6 Fig, 1 Tab, 37 Ref.

Descriptors: *Watersheds, *Sedimentation, Urban watersheds, Lake sediments, Copper, Lead, Erosion, Cesium, Pollens, British Columbia, Canada, Deer Lake.

Attempts were made to determine whether a record of human disturbance could be reconstructed from historical data and combined pollen and geochemical records of Deer Lake sediment. Palynological and geochemical studies were made on a 60 cm long sediment core to trace the effects of human disturbances since settelment. At 42.5 cm a settlement horizon was identified, about 1892, by pollen analysis. Declines in the percentages of coniferous tree species were mirrored by rapid increases in red alder and fern spores, and also by the presence of indicators of human influence, including introduced weeds, ornamental trees and herbs, and corn pollen. Marked increases in sedimentary aluminum, iron, potassium, titanium, and strontium soon after settlement coincided with declines in carbon, nitrogen, and sulfur. A corresponding shift from a highly organic gyttja to a silt- and clay-rich sediment also confirms the increased input up to the present day of inorganic sediment derived from soil erosion in the Deer Lake catchment. The deliberate introduction of copper sulfate around 1957 into the environment was recorded by a peak in copper at 19 cm. Increasing lead concentrations are correlated with post 1947-traffic increases. The peak radioactivity of cesium-137 at 17 cm correlated with the maximum in above ground bomb testing of 1963. Sediment accumulation rates were relatively constant from settlement until 1963, increasing to 1.06 cm/year since that time. An increased pollen influx since 1963 suggests a recent increase in runoff and soil erosion. (Baker-FRC)
W83-04110

SURFACE WATER CONTAMINATION BY INSECTICIDES: DATA FROM AQUATIC INSECT TESTS THAT PERTAIN TO WATER QUALITY CRITERIA,
Ohio State Univ., Columbus. Dept. of Entomology.
W. J. Collins, and R. Shank.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105378, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center Completion Report, September 1983. 75 p, 14 Fig, 7 Tab, 64 Ref. OWRT A-062-OHIO(1).

Descriptors: *Pesticide toxicity, *Aquatic insects, *Enzymes, Inhibitors, Acclimatization, Water quality, Water pollution, Metabolism, Respiration, Mayfly, Stonefly, Caddisfly, Midge, Winter, Summer, *Parathion, *Paraoxon, *Organophosphate insecticide, *Acetylcholinesterase, Mixed-function oxidase, Temperature effects.

Seven species of aquatic insects representing four orders were collected from natural waters in winter and summer seasons to investigate seasonal variation of toxicity of parathion and paraoxon, oxidative metabolism of these two chemicals and inhibition of acetylcholinesterase by paraoxon. Parathion was more toxic than paraoxon to both summer and winter forms of insects at 22C and 4C, respectively. The acetylcholinesterase of summer and winter forms exhibited the same inhibition characteristics with paraoxon. There was no evidence for the existence of different seasonal isoenzymes of acetylcholinesterase in these species. Parathion is oxidatively metabolized (mixed-function oxidase) in aquatic insects but paraoxon was not. The toxicity of parathion was highest in those insects with the highest oxygen consumption. A midge exposed to parathion acquired high (> 85%) inhibition of acetylcholinesterase before toxic symptoms were observed and inhibited acetylcholinesterase required 4 to 5 days for regeneration. These data are related to water quality criteria for parathion and provide information on seasonal variation of susceptibility to organophosphate insecticides in aquatic insects.
W83-04139

EFFECT OF HARDWOOD LEAF LITTER ON WATER QUALITY AND TREATMENT IN A WESTERN OREGON MUNICIPAL WATERSHED,
Oregon State Univ., Corvallis. Dept. of Forest Engineering.
R. L. Taylor, P. W. Adams, P. O. Nelson, and R. J. Seidler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105410, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-82, Oregon State Univ., Corvallis, September 1983. 56 p, 11 Fig, 5 Tab, 34 Ref, 10 Append. OWRT A-058-ORE(1), 14-34-0001-2139.

Descriptors: *Forest litter, *Leaf litter, Riparian vegetation, *Red Alder (Alnus rubra), *Municipal watersheds, *Watershed management, Watershed protection, Water quality, Water quality management, Water treatment, Water supply, Water color, Leaching, *Organic matter, *Organic carbon, Phenols, Trihalonethane, Chlorination, Coagulation, Bacteria, Coliforms, *Oregon, Seaside municipal watershed.

Riparian red alder stands are common in western Oregon and have been suspected in causing domestic water quality and treatment problems during autumn leaf fall. Studies on the Seaside Municipal Watershed showed potential water quality effects (particularly increased color) from alder leaves during unusually low autumn flows, but 1981-82 monitoring revealed no chronic problems. Laboratory leaching of alder leaves in filtered stream water indicated a fairly constant release of colored organics over time; water color increased linearly with increasing leaf mass leached. Ultraviolet absorbance (254 nm) related strongly to dissolved organic carbon levels in the leaf extracts. Chlorine demand of the extracts, based on total organic carbon (TOC), averaged 1.7 mg Cl sub 2/mg TOC. Trihalomethane (THM) formation in the extracts increased as pH and Cl sub 2/TOC ratio increased, with 60 mg CHCl sub 3/mg TOC formed at pH = 8.5 and Cl sub 2/TOC ratio = 4.3/1. Natural organics in stream water from the Seaside watershed produced less THM's and chlorine demand per mg TOC than the extracts. Coagulation with a cationic polyelectrolyte was partially successful in removing organics from the extracts. Observed chlorine demand and rapid regrowth of coliform bacteria in extracts suggest potential disinfection problems where alder leaf inputs are significant.
W83-04142

PHYTOPLANKTON UPTAKE AND SEDIMENT RELEASE OF NITROGEN AND PHOSPHORUS IN THE CHOWAN RIVER, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
E. J. Kuenzler, K. L. Stone, and D. B. Albert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105444, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 186, North Carolina State Univ., Raleigh, September 1982. 159 p, 40 Fig, 18 Tab, 145 Ref, 1 Append. OWRT B-127-NC(12), 14-34-0001-0274.

Descriptors: *Eutrophication, *Nutrients, *Limiting nutrients, *Phytoplankton, Algae, Cyanophyta, Seston, Nitrogen, Nitrate, Ammonium, Phosphorus, Phosphate, Sediments, Radioactive tracers, *North Carolina, Chowan River, Algal blooms.

The lower part of the Chowan River has suffered from blue-green algal blooms in recent years as a result of increased loading of nutrients. These nutrients(nitrate, ammonium, and phosphate) were reduced to lower concentrations during the warm seasons when algal growth was rapid and were more concentrated in winter and early spring when ammonium and phosphate were introduced by pulp-mill effluent. Uptake of ammonium by seston varied greatly; it was fastest during the blue-green bloom. Nitrate uptake averaged only a third as fast as the annual ammonium uptake rate. Phosphate uptake was predominantly biotic; the rates varied, with highest rates occurring at downstream stations in warm weather when algae were abundant. Fluxes of ammonium and phosphate from the sediments to the water were highly variable. Although nitrogen and phosphorus are abundant in the sediment, the rate of exchange to the overlying water is not the basic cause of the eutrophic condition of the water column. Analysis suggests that nitrogen or phosphorus may limit algal growth at different times and places in the river. However, indications are that phosphorus is the more important limiting nutrient. Elimination of the algal bloom problem in the Chowan River will be accomplished only by reducing nutrient loading from the watershed, especially phosphorus loading.
W83-04146

ECOLOGY AND VIRULENCE OF LEGIONNAIRE'S DISEASE BACTERIA IN AQUATIC HABITATS NEAR MT. ST. HELENS,
Oregon State Univ., Corvallis. Dept. of Microbiology.
D. L. Tison, and R. J. Seidler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105493, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-84, Oregon State Univ. Corvallis, September 1983. 12 p, 3 Fig, 1 Tab, 9 Ref. OWRT A-060-ORE(1), 14-34-0001-2139.

Descriptors: *Legionella, *Legionnaire's disease bacteria, Bacteria, Aquatic bacteria, Diseases, Aquatic habitats, *Mt. St. Helens, *Spirit Lake, *Washington.

Illnesses among researchers exposed to lakes and streams in the Mt. St. Helens blast zone after the 18 May 1980 eruption prompted us to determine the occurrence and potential virulence of Legionella (Legionnaire's disease bacteria) in aquatic habitats near Mt. St. Helens during the summers of 1981 and 1982. Concentrations of L. pneumophila, L. Micdadei, L. gormanii, L. dumoffii, and L. bozemanii, determined by microscopic counts using direct immunofluorescent staining, ranged from <10 super 4 to 10 super 5 cs/L in lakes and rivers outside of the Mt. St. Helens blast zone while the numbers of Legionella in aquatic habitats inside the blast zone were from 10 super 5 to 10 super 7 cells/L. Legionella numbers were consistently highest in N. Coldwater and Spirit lakes, which received water from hydrothermal seeps. Legionella pneumophila serogroups 4 and 6 were isolated from N. Coldwater Lake in 1981 and from S. Coldwater Creek in 1982, indicating the potentially virulent strain of Legionella persist in aquatic habitats in the blast zone of Mt. St. Helens.
W83-04151

POLLUTION EFFECTS ON ECOBIOLOGY OF BENTHIC POLYCHAETES IN VISAKHAPATNAM HARBOUR (BAY OF BENGAL),
Andhra Univ., Waltair (India). Dept. of Zoology.
A. V. Raman, and P. N. Ganapati.
Marine Pollution Bulletin, Vol 14, No 2, p 46-52, 1983. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Benthic fauna, *Organic wastes, *Sediments, Water pollution effects, Visakhapatnam Harbor, Bay of Bengal, *India, Polychaetes, Invertebrates, Industrial wastes, Water circulation,Tidal currents, Fate of pollutants, Harbors.

The physiochemical and biological characteristics of six stations along a decreasing gradient of organic pollution were studied in Visakhapatnam Harbor, India, during 1976-77. An outer harbor, finished in 1975, had further reduced sluggish water circulation and tidal flushing. The harbor receives municipal and industrial effluents. The benthic fauna were predominantly polychaetes (72 species). Three distinct assemblages were noted: Capitella capitata-Nereis glandicincta in the inner harbor, Cossura coasta-Tharyx marioni in the outer harbor, and Chloeia-Axiothella-Chaetozone-Nephtys in the open sea. Four zones were defined: very polluted (within 150 m of the sewage outfall, no bottom life, septic sediments); polluted (most of the inner harbor, 12 species of polychates); semi-healthy zone (outer harbor, 20 species of polychaetes); and healthy zone (open sea, 50 species of polychaetes). Dissolved oxygen levels in the water varied from nearly zero near the outfall to saturation in the open sea. Organic content of the sediment ranged from 7.31% at the outfall to 3.5% in the inner harbor, 2.1% in the outer harbor, and 0.93% in the open sea. (Cassar-FRC)
W83-04165

THE DEPAUPERATION OF EPIFAUNA ON PINNA BICOLOR NEAR A LEAD SMELTER, SPENCER GULF, SOUTH AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Cronulla (Australia). Div. of Fisheries Research.
T. J. Ward, and P. C. Young.
Environmental Pollution, Series A, Vol 30, No 4, p 293-308, 1983. 3 Fig, 6 Tab, 22 Ref.

Descriptors: *Mollusks, *Heavy metals, *Water pollution effects, *Marine sediments, *Benthic fauna, *Species composition, Lead, Marine animals, Species diversity, Ecological effects, Organic carbon, Water pollution sources, Spencer Gulf, *Australia.

Species richness and composition of the epifauna on Pinna bicolor, a large benthic bivalve mollusk, were examined near a lead smelter located on Spencer Gulf, South Australia. Mollusks were collected from areas of high and low sediment metal concentration. Two independent gradients were found in the species composition of the epifauna. The first gradient extended from the contaminated to the less contaminated areas, while the second passed from shallower sites toward deeper sites. The first faunal gradient correlated with numerous sediment parameters such as Ca, Ni, total organic carbon, clay, Cu, Mn, Pb and Zn, suggesting an epifaunal response to both contaminant metals and the resuspension of solids from the sediments. Of the 55 taxa of epifauna, 13 were associated with the faunal gradient between metal-contaminated and uncontaminated areas. More bryozoan and sponge species than mollusk species correlated to this change, suggesting differing sensitivities to the causal factors. (Geiger-FRC)
W83-04174

CONTINUED STUDIES OF ACID RAIN AND ITS EFFECTS ON THE BATON ROUGE AREA,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W83-04186

A NOTE ON THE GROWTH OF THIOTHRIX IN ROAD DRAINAGE DITCHES,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5B.
W83-04199

5D. Waste Treatment Processes

EXTRACTION OF PRIORITY POLLUTANTS FROM SOLIDS,
Iowa State Univ., Ames.
D. E. Harrold, and J. C. Young.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1211-1227, December, 1982. 9 Fig, 3 Tab, 20 Ref.

Descriptors: *Organic compounds, *Organic solvents, Pollutant identification, *Separation techniques, Model studies, Fate of pollutants, Organic acids, Volatile acids, Activated carbon, Gas chromatography, Pollutants, *Waste recovery, *Recycling, *Wastewater treatment.

The growing interest in the recycling waste materials has made the identification and fate of organic pollutants in solid matrices an area of great concern. Tests have been formulated to determine the efficiency of using Soxhlet procedures for the extraction of semivolatile organic priority pollutants from solid samples. Twenty-one compounds found on the EPA list of semivolatile organic priority pollutants were extracted from model sample systems consisting of mixtures of distilled water and granular activated carbon solids. Test variables included the time of solvent contact, particle size of solid matrix, and type of solvent. Extraction efficiencies varied substantially for different priority pollutants, and solvent losses significantly affected recovery when extraction times exceeded 24 hr. The most vital factor in obtaining maximum recovery seemed to be the contact time during extraction. Benzene was the best solvent for the extraction of semivolatile organics in the solids model and extraction procedures used. Particle size had only a minor effect on extraction efficiency. The Soxhlet procedure is useful in estimating the quantitites of semivolatile priority pollutants in solids when extraction efficiencies and other sources of error are taken into account. (Geiger-FRC)
W83-03859

EFFECT OF TILE DRAINAGE ON DISPOSAL OF SEPTIC TANK EFFLUENT IN WET SOILS,
Oregon State Dept. of Environmental Quality, Portland.
S. A. Wilson, R. C. Paeth, and M. P. Ronayne.
Journal of Environmental Quality, Vol 11, No 3, p 372-375, 1982. 4 Tab, 23 Ref.

Descriptors: *Septic tanks, Drainage systems, *Saturated soils, Willamette Valley, *Oregon, *Tile drains, Wastewater treatment, Wastewater disposal, Coliforms, Nitrates.

Tile drainage installed around septic tank disposal fields allowed effective aerobic decomposition of the effluents in the poorly-drained soils of the Willamette Valley, Oregon. Tile drains were either 1.2 m deep with a 3 m horizontal separation from the disposal trenches or 1.8 m deep with a 6 m separation. Water table drawdowns were 94 to 117 cm in the 1.8 m deep system and 56 and 75 cm in the 1.2 m deep system. In some fields poor drawdown was caused by the influences of old field tile. Nitrate levels in tile drain discharges were all below the 10 mg per liter drinking water standards. Fecal coliform levels were below 200 organisms per 100 ml, except for 2 systems. (Cassar-FRC)
W83-03879

EFFECTS OF DETERGENT FORMULATION ON THE PERFORMANCE OF SEPTIC SYSTEMS,
For primary bibliographic entry see Field 5B.
W83-03924

ENERGY-EFFICIENT AERATION OF ACTIVATION BASINS (ENERGIEFREUNDLICHE BELUFTUNG VON BELEBUNGSBECKEN),
W. Grimmel.
Waser, Luft und Betrieb, Vol 25, No 1/2, p 30-31, January/February, 1981. 3 Fig, 4 Tab, (No English Summary).

Descriptors: *Aeration, Activated sludge process, *Energy, *Wastewater treatment, *Design criteria, Installation, Economic aspects, Costs, Construction costs, Reverse current aeration, Biological oxygen demand, Nitrification, Phosphorus removal, Basins, Air circulation.

The IBO reverse current aeration system for sludge activation basins is described. Along the inner walls of the basin, aeration pipes are installed at regular intervals near the floor, while a concave sheet-steel cylinder containing a slowly rotating propeller is mounted in the basin's center. Small air bubbles rise to the surface by means of a spiral forced upward current, while the main current is directed downward. The path of the air bubbles is significantly lengthened by this circulating reverse current, which results in a higher level of oxygen exploitation. Ascent speeds lie between 15 and 26 cm/sec, which alows a through mixing of the biomass and a high degree of contact surface renewal. In trial runs it was shown that the system results in performance levels at least 25% higher than those attained by other aeration procedures. Turbulence speeds were 25-30 cm/sec near the basin floor, high enough to prevent activated sludge deposition. In some trials, automatic oxygen control was used for the various stages of the compressor; in others, a continuous compression drive was used (air/oxygen yield was 2.25-2.80 kg 02-kilowatt hr). During a long-range trial, energy consumption was 0.83 kilowatt hr/kg 5-day BOD, which is considerably less than the minimum level reported to date in the literature (1.0 kilowatt hr/kg 5-day BOD). When an activated sludge basin using rotation aeration was converted to reverse current aeration, daily energy consumption was halved (240 vs 110 kilowatt hr); 5-day BOD degradation was almost 98%, nitrification level was > 90%, and phosphate removal was > 70%, while with rotation aeration COD and 5-day BOD degradation and other parameters were an average of

30% lower. The advantages of the system include problem-free regulation, optimal aeration that covers the amount of oxygen actually required at a given time, flexibility to cover variable loads, cost savings due to low energy consumption, high purification level, simple conversion possibilities, and reasonable investment costs. (Gish-FRC)
W83-03925

THE JET NOZZLE--A NEW SUBMERGED AERATOR (DIE STRAHLDUSE--EIN NEUER TAUCHBELUFTER).
Wasser, Luft und Betrieb, Vol 25, No 7/8, p 18-19, July/August, 1981. 3 Fig. (No English Summary).

Descriptors: *Nozzles, *Jets, *Aerators, *Activated sludge process, *Industrial wastewater, *Wastewater treatment, *Belgium, Jet nozzle, Aeration, Momentum transfer, Oxygenation, Denitrification, Oxygen transfer, Biological wastewater treatment.

The use of a jet nozzle as a submerged aerator in the sludge activation basin is described. The system is in use at a biological wastewater treatment plant in Antwerp (Belgium) that serves 25 industrial works and discharges effluent into the Schelde river. The jet nozzle operates in a horizontal position on the floor of the activation tank. Activated sludge is continuously pumped into the power jet nozzle, where it is accelerated into a fast free jet, which draws in approximately ten times its original volume flow from the surrounding activated sludg through transfer of momentum. After it leaves the jet nozzle, the power jet enters a momentum exchange pipe, while the liquid it has absorbed flows through the area where the free jet leaves the mouth of the nozzle. Thus the air leaving the air nozzle (which surrounds the power jet nozzle) is dispersed in the shear field between the fast power jet and the slow-moving surrounding matter and is also mixed with a large amount of liquid in the turbulent momentum exchange. This results in small air bubbles being kept apart rather than forming larger bubbles with a smaller surface area. A rotation of the air/liquid mixture around a horizontal axis is achieved by the combined action of the forward-directed flow momentum and the uplift drive of the air bubbles. This results in the air bubbles returning to the bottom of the basin after they have risen to the surface, so that they remain in the liquid longer. This phenomenon, together with the small bubble size (large contact zone area), ensures an effective oxygen transfer. (Gish-FRC)
W83-03926

WASTEWATER TREATMENT WITH INDUSTRIAL OXYGEN (ABWASSERBEHANDLUNG MIT TECHNISCHEM SAUERSTOFF),
Linde A.G., Hollriegelskreuth (Germany, F.R.).
K. -H. Gregor.
Wasser, Luft und Betrieb, Vol 25, No 6, p 14-15, June, 1981. 3 Fig, (No English Summary).

Descriptors: *Oxygenation, *Industrial wastewater, *Municipal wastewater, *Wastewater treatment, *Water treatment, Unox procedure, Drinking water, Sludge thickening, Sludge digestion, Aerobic treatment, Nitrification, Denitrification, Nitrogen removal, Oxidation, Ozonation, Flotation, Separation techniques, Oxygen, Disinfection.

Various uses of the Unox (Lindox in the Federal Republic of Germany) procedure in wastewater treatment are described. The procedure is employed for treating municipal wastewater (including nitrification), sludge from domestic wastewater treatment plants, and industrial wastewater, and is particularly effective for wastewater that is difficult to treat, e.g., water with highly variable pollution loads and with malodorous constituents. Unox is a space-saving system that allows aeration with smaller basin volumes than in conventional methods. Nitrogen elimination rates of > 90% are achieved through a nitrification/denitrification procedure. Unox offers aerobic thermophilic (as well as mesophilic) sludge stabilization, in which excess sludge is stabilized through the introduction of oxygen. A new dual digestion (DD) system has been devised that combines this aerobic sludge treatment with conventional digestion. DD is characterized by significantly shorter retention times (smaller digestion volume). Unox is used together with ozonation (ozone is manufactured from industrial oxygen, which is used for aeration in Unox) for disinfection in drinking water treatment. Waste gas from Unox facilities contains more oxygen (about 50%) than air, so is more soluble in aqueous solutions. Thus the use of this gas instead of air in sludge thickening results in a higher concentration of flotated solids, greater throughput volume for a given flotation chamber volume, and cost reduction through decreased energy requirement to release flotation gas. New systems are being developed, e.g., for heavy metal removal from sludge. (Gish-FRC)
W83-03927

PRESSURE-RELEASE FLOTATION, PRACTICAL EXPERIENCE FROM SWEDEN (ENTSPANNUNGSFLOTATION. PRAKTISCHE ERFAHRUNGEN AUS SCHWEDEN).
Wasser, Luft und Betrieb, Vol 25, No 9, p 18, 23, 24, September, 1981. 3 Fig, (No English Summary).

Descriptors: *Flotation, *Water treatment, *Wastewater treatment, *Sludge thickening, *Tertiary wastewater treatment, *Sweden, Pressure-release flotation, Drinking water, Sedimentation, Precipitation, Suspended solids, Algae, Filtration.

Water quality demands in Sweden are high. The technique of pressure release flotation is used in Sweden in wastewater treatment facilities with a throughput of up to 16,000 cu m/hr. The procedure involves reintroducing treated water into the treatment basin inlet and saturating it with air in a pressure tank before mixing it with the basin contents. Gas bubbles that are freed by the reduction in pressure attach themselves to dirt particles and carry them to the surface. Air bubbles of 30-80 micron are produced, a size that cannot be achieved through direct injection. The advantages of pressure-release flotation are significantly increased throughput and better purification capacity due to the small size of the bubbles. Higher sludge concentrations result, sometimes obviating the need for further thickening. The procedure has long been used successfully for drinking water treatment, raw materials recovery and water recycling, industrial and municipal wastewater treatment, and sludge thickening. In a comparison study at a drinking water treatment plant (capacity up to 600 cu m/hr), chemical use was one-third less for pressure release flotation than for sedimentation, and drinking water production doubled with flotation; the reason for this was the high level of suspended matter removal (especially algae). A further development is to combine pressure-release flotation with filtration using a flotation filter, for use in the treatment of high-quality water. (Gish-FRC)
W83-03928

THE OPERATION, MAINTENANCE AND RENOVATION OF SEWERAGE SYSTEMS AND PUMPING STATIONS IN A LARGE MUNICIPALITY,
J. W. Sellek.
Water Pollution Control, Vol 81, No 5, 645-654, 1982. 6 Fig, 2 Tab, 4 Ref.

Descriptors: *Sewer systems, *Rehabilitation, *Inspection, Manchester, *England, Maintenance, Cleaning.

The sewer system of Manchester, England, dating back to 1792, has required many repairs in recent years. The operation and maintenance work has been complicated by a lack of records for the period before 1830. Most of the early system is not large enough for man entry. Therefore, inspection and cleaning has been inadequate. Highway subsidence (50 cases since 1976) is frequent and expensive to repair. A plan for maintenance and renovation of the sewer system has been devised. Inspection via man entry or television will be directed first toward the main interceptors, then the local distributing sewers (oldest sewers and most important roads first) and local sewers. A program for manhole construction in the older sections will improve access. Of the methods available for renovation and renewal, reconstruction is the most expensive but most satisfactory, having an anticipated life of up to 150 years. For sewers in early stages of deterioration, cleaning, repointing, and grouting are satisfactorily, but labor-intensive, techniques. (Cassar-FRC)
W83-03929

OXYGENATED ACTIVATED-SLUDGE PROCESS: EVALUATION AT PALMERSFORD,
Water Research Centre, Stevenage (England).
A. J. Blachford, E. M. Tramontini, and J. A. Griffiths.
Water Pollution Control, Vol 81, No 5, p 601-618, 1982. 8 Fig, 11 Tab, 41 Ref.

Descriptors: *Activated sludge, *Oxygenation, *Biological wastewater treatment, Palmersford, *United Kingdom, Aeration, Unox process, Bulking sludge, Energy.

An oxygenated activated sludge plant (OASP), also known as the Unox system, was installed in 1975-76 at Palmersford, England. This plant has treated 5.1 tcmd of settled sewage at a sludge loading rate of 0.46 kg per kg-day to produce an effluent with median values of 5 mg per liter BOD, 9 mg per liter suspended solids and 26% nitrification. Complete nitrification was achieved in the aerated second stage of treatment. Increasing the sludge loading to 0.98 kg per kg-day increased the BOD to 21 mg per liter and the suspended solids to 26 mg per liter. Compared with a conventionally aerated system the OASP produced a similar effluent with less nitrification and 21% less sludge. Energy required by the OASP process was 1.8-4.1 kWh per kg BOD and ammonia oxidized. Energy use was 70% higher than in the conventional aerated plant per unit of sewage treated. The pressure swing absorption unit, which generates oxygen, has been nonoperational only 5.6% of the time. (Cassar-FRC)
W83-03930

EFFECTIVE USE OF STOM,
Water Research Centre, Stevenage (England).
R. H. Chambers, and B. W. Spearing.
Water Pollution Control, Vol 81, No 5, p 655-664, 1982. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Model studies, *Performance evaluation, *Activated sludge process, *Wastewater treatment, Sewage Treatment Optimization Model, STOM, Design criteria.

The Sewage Treatment Optimization Model (STOM), designed to help in design and operation of new and extended sewage treatment works, has been used extensively since late 1980. It can be used in 2 modes: fixed-mode, for calculating the performance and cost of a given works from the flow rate and composition of influent, and optimized-mode, to give the specified effluent for the minimum annual treatment cost. Thus far, the major use of the model has been in improving performance or planning extensions of existing works. One problem with the model has been insufficient performance, operational, and design data for input into the model. Especially important, but often unknown, are type and size of biological filter media, mixed liquor suspended solids concentrations in the activated sludge stage, and the temperature of the sewage. Proposed additions to the model include provision for hot climates, anoxic zones, nitrifying filters, and humus-settlement tanks. (Cassar-FRC)
W83-03931

MARKET CHANCES FOR MEMBRANE PROCEDURES IN THE 1980S (MARKTCHANCEN FUR MEMBRANVERFAHREN IN DEN 80ER JAHREN),
Gesellschaft fuer Wirtschaftsforderung und Marktplanung m.b.H., Frankfurt am Main (Germany, F.R.).
G. Dippel.
Wasser, Luft and Betrieb, Vol 25, No 4, p 17, 18, 23, April, 1981. (No English Summary).

Descriptors: *Membrane processes, *Reverse osmosis, *Ultrafiltration, *Marketing, *Forecasting, Projections, Predictions, Membrane filters, Filtration, Wastwater treatment, Water treatment, Milk, Dairy industry, Disinfection, Oily water, Metal-finishing wastes, Food processing industry, Wash water, Economic aspects, Costs.

Results of a 1979 West German study are reported, in which the possiblities for installation of membrane filtration processes (ultrafiltration, UF, and return osmosis, RO) in various industries for the 1980s were assessed. Although approximately 55,000 companies were studied, it is expected that for technical and economic reasons, only about 3,500 membrane filtration facilities will be installed by 1990. About two-thirds of these will be UF plants, most of which will be used in the metal and milk processing industries. For RO facilities, the most important markets will be the treatment of boiler feed water, followed by water treatment for air conditioning systems (particularly where a high degree of disinfection is required, e.g., in industrial sterile rooms and hospitals) and for hemodialysis water for hospitals. In the metal processing industries, additional possible applications include the separation of oil-water mixes (UF has been used successfully and cost-effectively here), electro-dip lacquering (UF use can result in lacquer recovery of up to 95% and has cost advantages), purification of wash water (RO), and treatment of oily wastewater (UF). RO has been considered as a supplement to ion exchange for wash water desalination in the galvanizing field, but no facilities are foreseen for both technical and cost reasons. In the food industry, no applications are expected other than in the milk sector, though membrane procedures have been considered for the manufacture of alcohol-reduced beer (RO), wine production, fruit-juice concentration (RO could possibly be used commercially in a few instances here), meat and fish processing (UF for protein concentration from wastewater, cooking and wash waters, and blood), and nutrient production (e.g., UF for yeast wash water treatment). Technical development is not yet refined enough to allow widespread use of membrane filtration in the chemical and pharmaceutical industries. Possible future applications are expected in the textile, cellulose and paper (RO for wastewater treatment), and leather (UF for process water treatment) industries. (Gish-FRC)
W83-03941

CIRENCESTER CARROUSEL PLANT: SOME PROCESS CONSIDERATIONS,
Thames Water Authority (England). Cotswold Div.
D. W. M. Johnstone, and W. F. Carmichael.
Water Pollution Control, Vol 81, No 5, p 587-600, 1982. 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Oxidation ditches, *Nitrogen removal, *Oxygen requirements, Wastewater treatment, Cirencester Plant, *United Kingdom, Carrousel process, Aeration, Ditches, Biological wastewater treatment, Sludge digestion, Performance evaluation, Digestion, Nitrification, Denitrification, Anaerobic conditions.

Operational data collected from 1977 to 1980 at the Cirencester Carrousel plant (oxidation ditch) yielded information on oxygen requirements, energy consumption, and factors affecting nitrification/denitrification. Equations were developed to describe theoretical oxygen demand, which varied from 2000 to 4000 kg per day. Sludge respiration was the most significant component of the oxygen requirement, which also considered oxidation of carbonaceous substrate and nitrification/denitrification. Inorganic N removal varied from zero to 90%. Nitrification was impaired during a period of rising mixed liquor suspended solids and rising temperature. Full denitrification occurred during a three month period of excess oxygen supply and during a 5 month period of very low effluent ammonia and nitrate concentrations with large anoxic zones. Diurnal variations in sewage concentration and volume made control of denitrification difficult due to a lag in the size of the anoxic zones. (Cassar-FRC)
W83-03944

INITIAL OPERATING EXPERIENCES OF UPRATING DISS SEWAGE TREATMENT WORKS USING THE BOC VITOX SYSTEM,
Anglian Water Authority, Norwich (England). Norwich Sewage Div.
B. V. Crook, D. B. Cudby, and C. Jeffries.
Water Pollution Control, Vol 81, No 5, p 633-644, 1982. 3 Fig, 7 Tab, 8 Ref.

Descriptors: *Vitox system, *Oxidation ditches, *Wastewater treatment, Pasveer Ditch, Ditches, Diss, *United Kingdom, Oxygenation, Biological wastewater treatment, Sludge digestion, Digestion, Oxygen requirements.

The BOC Vitox System was incorporated into the Diss, England sewage treatment system to quickly uprate the existing unreliable Pasveer ditch. The system, installed within 6 weeks of ordering, restored stability to the poorly operating ditch and accomodated a 10-15% increase in sewage diverted from an adjoining village. Apparently about 30% of oxygen delivered to the site is lost for unknown reasons. Effluent contained 6.6 mg per liter BOD (98.4% removal), 17.4 mg per liter total suspended solids, 1.5 mg per liter ammonia-N (95.7% removal), and 28.5 mg per liter nitrates. For the Diss sytem the respiration rate at 20C was determined to be 6.5 mg 02 per g sludge per hour, higher than the published value of 3.9 mg 02 per g sludge per hour. (Cassar-FRC)
W83-03946

INITIAL OPERATING EXPERIENCES AT CIRENCESTER CARROUSEL PLANT,
Thames Water Authority (England). Cotswold Div.
W. F. Carmichael, and D. W. M. Johnstone.
Water Pollution Control, Vol 81, No 5, p 573-586, 1982. 8 Fig, 4 Tab, 7 Ref.

Descriptors: *Sludge digestion, *Aeration, *Oxidation ditches, Ditches, Wastewater treatment, Cirencester Plant, *United Kingdom, Carrousel process, Biological treatment, Performance evaluation, Digestion.

This paper describes the Cirencester Carrousel sewage treatment system and the initial operating results. After grit removal, sewage is pumped to an 88 m long aeration ditch, consisting of four 7 mile wide channels 2.5-3.5 m deep. The retention period is 33 hours. Facilities for tertiary treatment, storm water storage, and sludge thickening are also provided. This plant has been easy to operate. Aeration efficiency of the Simcar Aerators was highest (2.6 kg 02 per kWh) at 42% immersion. At a BOD loading of 732 kg per day (53% of design) good quality effluents were produced: 8 mg per liter BOD, 6 mg per liter ammonia, and 5.7-17.5 mg per liter suspended solids. Up to 90% removal of inorganic N occurred under eighter full nitrification or nitrification/denitrification. At high mixed liquor suspended solids nitrification and sludge settleability were impaired. Sludge production was 1 kg per kg BOD removed. Energy consumption was 1.2-2.1 kWh per kg BOD removed. (Cassar-FRC)
W83-03947

ASPECTS OF THE PERFORMANCE OF FINAL CLARIFIERS IN THE ACTIVATED SLUDGE PROCESS,
Stewart, Sviridov and Oliver, Marshalltown (South Africa).
C. Davis.
Water Science and Technology, Vol 14, No 9-11, p 1514-1518, 1982. 3 Fig, 4 Ref.

Descriptors: *Design criteria, *Activated sludge process, *Clarifiers, Clarification, *Wastewater treatment, Sludge.

Ideas regarding the design, detailing, monitoring and operation of clarifiers are considered. Designers now tend to consider flux in addition to upflow rate when sizing a clarifier. Without prior knowledge of the sludge characteristics, it is not possible to apply flux theory. Therefore the designer requires a design limit for flux. In the absence of theory to determine side wall depth for a clarifier, it is prudent to regard 3 meters as a safe minimum. Shallower tanks are prone to failure under shock loads. Apart from basic design and sizing, a clarifier also demands careful detailing. One particularly troublesome area is scum removal. For monitoring, the traditional measure of sludge characteristics is the SVI test. The plant operator can manipulate sludge age, oxygenation and sludge return ratio in order to optimize performance. For oxygen deprived plants with fairly long liquid detention times of 12-24 hr, a sludge age between 20 and 30 days can be expected to produce a good sludge. While some evidence has been suggested for bulking at low oxygenation rates, this was not the case at the plants studied. Sludge return ratio has a profound effect on the thickening, and it is best to restrict the return ratio to range of 0.5 to 4.0. Where alternating aerobic-anoxic-anerobic conditions are desired, use of high ratios can assist the cyclic effect, but may also lead to turbulence and clarifier failure. (Baker-FRC)
W83-03951

PRECIPITATION OF CALCIUM PHOSPHATE AND PH-EFFECTS IN DENITRIFYING BIOFILMS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
E. Arvin, and G. H. Kristensen.
Water Science and Technology, Vol 14, No 9-11, p 1505-1508, 1982. 10 Fig, 2 Ref.

Descriptors: *Biofilms, *Denitrification, Acidity, Phosphates, Mathematical models, Hydrogen ion concentration, Chemistry of precipitation, Calcium compounds, *Wastewater treatment.

Denitrification was studied in a fixed bioflim. During denitrification alkalinity (bicarbonate and carbonate) is produced. Due to diffusional resistance to outtransport of alkalinity pH increases with depth into the biofilm. The solubility of calcium phosphate compounds decreases with the biologically mediated pH increase. Thus calcium phosphate might precipitate. The experiments were performed in a laboratory fixed film reactor fed with an artificial substrate. The pH is measured in the bulk liquid and at the rear of the biofilm. After growing the biofilm the reactor is disassembled and biofilm samples are scraped off for analysis. A carbonate apatite has precipitated in the biofilm. The pH-effect and a mathemathical model fo this has been verified. It is concluded that denitrification in a fixed biofilm can create pH values in the biofilm considerably higher than the pH in the external bulk liquid. The pH increase inside the biofilm can initiate calcium phosphate precipitation. (Baker-FRC)
W83-03952

BIOCHEMICAL CHANGES ASSOCIATED WITH LUXURY PHOSPHATE UPTAKE IN A MODIFIED PHOREDOX ACTIVATED SLUDGE SYSTEM,
Pretoria Univ. (South Africa). Dept. of Biochemistry.
D. J. J. Potgieter, and B. W. Evans.
Water Science and Technology, Vol 14, No 9-11, p 1503-1504, 1982. 1 Fig.

Descriptors: *Phosphates, *Activated sludge process, Biochemical reactions, *Wastewater treatment, Phoredox, Nutrients, Nutrient removal.

Biochemical events in an activated sludge system were studied before and during luxury phosphate uptake. The aim of the study was to discover critical biochemical reactions involved in luxury phosphate uptake, the control of which would lead to satisfactory control of such processes. The concept on which the study was based is that phosphate accumulation is mainly a biological process, and that it results from an imbalance in the supply of energy, carbon skeletons and nitrogen during critical stages of microbial proliferation. Meaningful amounts of nitrogen, hydrogen sulfide, carbon dioxide and oxygen with traces of methane were found. Hydrogen sulfide and nitrogen showed an inverse relation, while hydrogen sulfide increased as the system acclimatized to 100% P removal. Involvement of gas production in the creation of imbalance is probably indicated. ATP (bacterial

and somatic), DNA, polyphosphate, and PHB profiles are presented. Adenylate energy charge is calculated. The divalent cations of calcium and magnesium may play a role in transport processes connected with phosphate release and uptake. Total and free amino acids in sludge were monitored at various stages of P removal. The observation that a rise in total N and P in the cells leads to a corresponding increase in total amino acids is interpreted in terms of the concept that an imbalance in the supply of energy, carbon skeletons and nitrogen is responsible for luxury phosphate uptake. (Baker-FRC)
W83-03953

MICROBIOLOGY OF NUTRIENT REMOVING ACTIVATED SLUDGE,
Johannesburg City Health Dept. Labs. (South Africa).
M. A. Hart, and L. N. Melmed.
Water Science and Technology, Vol 14, No 9-11, p 1501-1502, 1982. 1 Tab.

Descriptors: *Activated sludge process, *Bacteria, Sludge, Nutrients, *Nutrient removal, Acinetobacter, Bulking sludge, Phosphates, Poly-beta-hydroxybutyrate, *Wastewater treatment.

A description is offered of the modified Bardenpho nutrient removal system. The build-up of microbiological life from plant start-up is recorded, and Acinetobacter spp is identified as a major component of the Gram-negative group of bacteria in a number of plants. Problems with filamentous organisms are described. In this process the microbial life is exposed to alternating degrees of stress. Such conditions may result in the natural selection of microbial species differing from those found in conventional systems. To gain more knowledge in this regard the 150 ml/d Johannesburg Northern Works was monitored daily from the time it was started up on settled sewage. After seven days a negligible number of flagellates were seen, but no floc was visible until the tenth day. Next to appear were free swimming ciliates and amoeba, followed by a gradual compaction of the floc and the appearance of Phadophyra among other attached and crawling ciliates. Methylene blue staining showed the presence of phosphate deposits in cells having a coccal, rod, chain and cluster appearance. Multizone nutrient removing activated sludge plants appear to suffer from poor settling sludges. Filamentous growths often float in thick mats on the surface, especially in winter. Nocardia has been found to be present at certain plants and Microthrix parvicella at others. Changing conditions to either highly aerobic or anaerobic has been partially successful in abating this problem. One plant which is switched off during weekends has minimal difficulties in this regard. (Baker-FRC)
W83-03954

THE LOCATION AND NATURE OF ACCUMULATED PHOSPHORUS IN ACTIVATED SLUDGE,
Johannesburg City Health Dept. Labs. (South Africa).
L. Buchan.
Water Science and Technology, Vol 14, No 9-11, p 1497-1500, 1982. 3 Fig.

Descriptors: *Activated sludge process, *Phosphorus, *Bacteria, Fermentation, *Wastewater treatment, Chemical reactions.

To obtain further detail on the morphology of phosphorus accumulating organisms and the composition of the phosphorus accumulations, specimens of various activated sludges were examined in a transmission electron microscope and a scanning electron microscope equipped with an EDX attachment. Phosphorus-rich inclusions were shown to take up a large volume of the cell and to be electron dense. They appeared to be hard, spherical bodies which were often pulled out of the cell by the microtome knife during sectioning, leaving holes in the cell structure. Further they did not exhibit the diffraction pattern characteristic of crystalline structures. However, they could be degraded by increasing the intensity of the electron beam, whereafter diffraction patterns could be discerned. During degradation it was noted that these phosphorus-rich inclusions appeared to contain a spherical body of low electron density. Granules in Acinetobacter contained in excess of 25% (m/m) phosphorus with a Ca:P ratio between 0.15 and 0.36. Accumulation was possible under continuous aerobic culture and was enhanced by the presence of fermentation products from raw sewage. (Baker-FRC)
W83-03955

DESTRUCTION OF HAZARDOUS WASTES BY ULTRAVIOLET CATALYZED OXIDATION,
Connecticut Univ., Storrs. Inst. of Water Resources.
D. W. Sundstrom, and H. E. Klei.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265090, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, April 1983. 18 p, 8 Fig, 10 Ref. OWRT A-092-CONN(1), 14-34-0001-2107.

Descriptors: *Photooxidation, *Halogens, *Hydrogen peroxide, *Chemical oxidation, *Ultraviolet radiation, Hazardous materials, Water purification, Water pollution, Wastewater treatment, Water treatment.

Conventional wastewater treatment processes are ineffective on many hazardous organic compounds found in industrial wastes and domestic water supplies. This project examined the destruction of hazardous organic compounds in water by ultraviolet light catalyzed oxidation with hydrogen peroxide. Reactions were conducted in a batch reactor equipped with a stirrer and a low pressure mercury lamp to provide the ultraviolet light. The course of the reactions with time were followed by analyzing for the pollutants with a gas chromatograph. The compounds examined in the initial study were trichloroethylene and dichloromethane, which are representative of halogenated compounds found in contaminated water supplies. Rates of oxidation increased with increasing pollutant concentration, hydrogen peroxide concentration and temperature. Starting with an initial concentration of about 50 ppm trichloroethylene, the concentration was reduced to less than 1 ppm in 50 min at 20C and 10 min at 41C. All of the reacted chlorine was converted to chloride ion, indicating that the halogenated compounds were destroyed. This treatment method can be applied to the destruction of a wide spectrum of hazardous industrial compounds before discharge to the environment and will also be of value to homes and institutions with contaminated water. In addition to destroying hazardous organic compounds, this technique also kills most bacteria and viruses. This technology should be fairly easy to implement since ultraviolet lamps are readily available and hydrogen peroxide is a common industrial and household chemical.
W83-04002

CONTROLLING SULFIDES AND ODORS IN SEWERS. PART TWO,
Johnson (Bernard), Inc., Houston, TX.
M. A. Vivona, and G. A. Whalen.
Public Works, Vol 113, No 4, p 69-72, April, 1982. 2 Fig, 5 Tab, 7 Ref.

Descriptors: *Sulfides, *Odor control, *Sewers, Aeration, *Wastewater treatment, Dissolved oxygen, Temperature effects, Pumping, Corrosion, Wastewater collection, Forcemains, Materials testing.

Force main aeration and adjunctive feed of hydrogen peroxide have been installed at the Westville and Clayton pump stations of the Gloucester County Utilities Authority in New Jersey in an effort to control sulfides and odors in the sewers. This article discusses technical details of the aeration system. Various aspects of aeration efficiency are examined, including relief valve losses, assessment of quantitative loss, selection of desirable air feed rates, and the effects of seasonal changes in wastewater temperature on desirable air feed rates. Methods for estimating the effect of air relief valve losses on the theoretical flow in force mains are demonstrated. Plans for future evaluations of this wastewater treatment program are described. (Carroll-FRC)
W83-04018

EXPERIENCE IN THE FIELD OF OIL REMOVAL FROM POWER PLANT WASTEWATERS (ERFAHRUNGEN AUF DEM GEBIET DER ENTOLUNG VON KRAFTWERKABWASSERN),
Institut fuer Energetik, Leipzig (German D.R.).
H. Schuster.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 473-483, May 1980. 4 Fig, 4 Tab, 13 Ref. (No English Summary).

Descriptors: *Oily water, *Powerplants, *Wastewater treatment, *Waste recovery, Recycling, Oil pollution, Emulsifiers, Emulsion, Filtration, Fuel oil, Fuel, Coal, *German Democratic Republic, Solids, Separation techniques, Oil wastes.

Depending on the fuel and technology of power plants, wastewaters with varying concentrations of oil and solids are produced, so that different methods of treatment must be used. In the German Democratic Republic, power plants fired by brown coal are important. In these, oil-polluted wastewater contains mostly oil that has leaked from the oil pipeline system, although the water-steam circulating and cooling systems are also subject to leaks. In power plants fired by fuel oil, oil-polluted water may originate in rainwater contaminated during oil delivery, wash water, and runoff from drainage of oil storage areas and the boiler house. Maintenance and repair facilities may also be sources of oil-contaminated water. Depending on its source, the polluted water may contain soot, surfactants, salts, or solids, and be acid or alkaline. Gravity separation can be used to remove oil from wash water and leakage in solid-fuel plants; after this a solids separator is used to remove coal and ash solids. A successful pilot study was conducted in an East German brown-coal-fueled plant to use xylitol-containing furnace residues for adsorptive removal of oil in condensate. For oil-fired plants, the goal is not only to clean the polluted water but also to recycle the oil, soot, and metals (especially V205) that they contain. Simple oil removal is sufficient to treat all but wash water from oil-fired facilities. Research is being conducted into separating oil-contaminated wastewater from these plants into pure oil and aqueous phases by means of membrane filtration. In one brown-coal-fired plant's workshop, a tube wash facility has been installed to treat water containing detergents, grease, and oil emulsion. The process includes emulsion breaking by decreasing pH and separation of oil-carrying ash particles by filtration. (Gish-FRC)
W83-04048

SOME ASPECTS OF THE PRESENT STATUS OF ALGAE CULTIVATION AND THEIR APPLICATION (NEKOTORYE ASPEKTY SOVREMENNOGO SOSTOYANIYA KUL'TIVIROVANIYA VODOROSLEI I IKH PRIMENENIE),
C. V. Dilov.
Khidrobiologia, Vol 10, p 3-11, May, 1980. 20 Ref.

Descriptors: *Agriculture, *Algae, *Wastewater treatment, Feeds, Chlorella, Aquatic productivity, Proteins, Nutrients, Aquaculture, Spirulina, Scenedesmus.

Use of algae grown in waste water for animal feed has acquired greater significance with increasing prices of protein and increasing water shortages. Algae projects, not using waste water, include 45 units in Southeast Asia producing 1,000 kg dry Chlorella monthly and Spirulina production in Mexico. Projects in Germany, Thailand, Peru, India, and Israel are studying mass production of Scenedesmus. At present Chlorella and Scenedesmus are not suitable for use as primary protein sources for human consumption but have potential application as food additives. (Cassar-FRC)
W83-04073

PURIFICATION OF FAECAL WATERS COMBINED WITH ALGAL PROTEIN PRODUC-

TION (OCHISTVANE NA VODI S FEKALEN KHARAKTER, SUCHETANO S POLUCHAVANE NA VODORASLOV PROTEIN),
K. M. Benderliev, and C. V. Dilov.
Khidrobiologia, Vol 10, 12-26, May, 1980. 101 Ref.

Descriptors: *Algae, *Waste water treatment, *Agriculture, Aquaculture, Proteins, Nutrients, Water conservation, Pilot plants.

Algae were used to purify waste waters in laboratory and pilot plant studies reviewed in this paper. In addition to providing for waste treatment, algae production conserves agricultural water resources and reuses nutrients to provide protein. Large-scale implementation of this process is not considered feasible at this time. (Cassar-FRC)
W83-04074

INTENSIVE CULTIVATION OF MICROALGAE IN WASTE WATER FROM A PIG-BREEDING FARM,
C. V. Dilov, K. M. Benderliev, N. V. Cherkesov, and A. P. Atev.
Khidrobiologia, Vol 10, 27-33, May, 1980. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Algae, *Waste water treatment, *Agriculture, Chlorella, Pig wastes, Farm wastes, Chlorophyta, Scenedesmus, Chlamydomonas, Aquatic life, Nitrogen, Phosphorus, Chemical oxygen demand, Bacteria, Ammonia, Waste treatment.

Wastewater from a pig breeding farm was depleted by about 80% in nitrogen, phosphorus, and COD during algae culture experiments. Chlorella sp 4 and Chlorella sp 16b were the most promising isolates because they were thermophilic, comparatively resistant to ammonia toxicity, and had a short lag period in a highly loaded medium. Scenedesmus sp. showed some domination in mixed cultures. Also tested, but found noncompetitive, were Chlamydomonas, Euglena, Chlorogonium, Pyrobotrys, and Tetraedron. During an outdoor experiment algal-bacterial purification was more effective than bacterial alone, removing 1.5 to 2 times as much ammonia nitrogen and phosphates. COD removal was slightly higher than in the control. The algal-bacterial combinations used 57.14% of the nitrogen versus 26.14% for the control. Nitrogen lost was 40% in the algal-bacterial experiment; 74% in control. (Cassar-FRC)
W83-04075

DEEP TANK AERATION/FLOTATION, CLARIFICATION ADDS A NEW TREATMENT DIMENSION,
D. Rogers.
Industrial Wastes, Vol 29, No 1, p 10-17, 1983. 2 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Clarification, Aeration, Flotation, Energy conservation, Secondary wastewater treatment, Bacteria, Activated sludge process.

An innovative treatment facility at a Washington state pulp and paper mill proved the capabilities of the deep tank aeration/dissolved air flotation process in a difficult industrial application. The ITT Rayonier secondary treatment system is a variation of conventional high rate activated sludge systems, using deep tank aeration to provide a completely mixed aerobic environment for biological treatment. Secondary clarification is accomplished through the use of dissolved air flotation. The secondary treatment facility was designed to treat an average daily flow of 30 mgd with a raw waste loading of 310,000 lb BOD/day and 19,800 lb TSS/day. As a result of a partial sewer reorganization and a reduction in mill water usage, the treatment plant currently processes an average daily flow of 25 mgd, or about 85% of design capacity, and has a slightly longer detention time of 10.3 hr than design. About 15 mgd of untreated pulp mill process wastewaters are discharged with the treatment plant effluent after pH adjustment. During the three year operation of the treatment plant the overall BOD removal efficiency has averaged 85%, while soluble BOD removal was 97%. Soluble BOD accounted for only 23% of the effluent BOD, whereas it accounts for over 95% of the influent BOD. Effluent BOD and average SS discharges have been influenced greatly by grade changes, primarily changes from low to high RWL grades, where influent BOD loadings can increase by over two-fold in just a few hours. The average F/M ratio, while much higher than in conventional treatment plants, is below design. Since the influent TSS is only 50 mg/l, the MLSS in the tanks represents mostly bacterial cells. Also, the MLSS represents a high concentration of active cells because of the high F/M ratio and low sludge turnaround time from the clarifiers, about 15 min. Oxygen uptake rates range from 50 to 60 mg/l/hr and a corresponding respiration rate of 30 to 40 mg/g/hr. Secondary clarification by flotation is a reliable process. (Baker-FRC)
W83-04085

MEETING REGULATORY REQUIREMENTS THROUGH MINOR PLANT MODIFICATIONS,
Edde (Howard), Inc., Bellevue, WA.
H. Edde, J. Handley, G. Conn, and J. McDaniel.
Industrial Wastes, Vol 29, No 1, p 18-19, 1983. 2 Fig, 1 Tab.

Descriptors: *Wastewater treatment facilities, *Design criteria, Decision making, Aeration, Mixing, Biochemical oxygen demand.

Significant improvements were achieved in aeration tank mixing and an increase in tank volume was obtained through relatively simple and low cost piping modifications made at the Kalama Chemical Plant in Kalama, Washington. The following changes were responsible for the improvements. A 75 hp high speed aerator was replaced with a 125 hp diffused air system. Although effective in improving aeration tank mixing, it also increased the wastewater temperature and required more maintenance. The addition of river water to the treatment plant feed to control high operating temperatures was successful, particularly during the summer season when these temperatures were of great concern. Even with these changes the system was still subject to severe upsets when stressed by high temperatures of phenol spills. The settling characteristics of the sludge were poor, resulting in poor effluent quality and operational problems. The poor mixing in the aeration tank resulted primarily from improper design in the aeration tank piping. The return sludge should mix with the fresh wastewater feed at a point of intense agitation. A lithium tracer study revealed significant short-circuiting and dead spots within the aeration tank. The poor placement of the return sludge entrance, inadequate mixing and short-circuiting accentuated problems caused by variation in the wastewater BOD and/or phenol concentration. It was recommended that the return sludge be rerouted so that it entered the aeration basin in a common diffusion header with the wastewater feed. Conversion of the aerobic sludge digester to a second stage activated sludge aeration tank proved helpful. This was accomplished with piping and pumping modifications. (Baker-FRC)
W83-04086

FROM WASTEWATER TO DRINKING WATER,
Arber (Richard P.) Associates, Inc., Denver, CO.
R. P. Arber.
Civil Engineering (New York), Vol 53, No 2, p 46-49, 1983. 2 Fig.

Descriptors: *Water reuse, *Potable water, *Wastewater treatment, Drinking water, Water demand, Water supply development, Water resources development, Water supply, Reverse osmosis, Chlorination, Aeration, Filtration, Flocculation, Lime.

The Denver Water Department has embarked on a $29 million demonstration project to show the technical and economic feasibility of potable water reuse. The 1 million gallon per day demonstration plant produces potable water from sewage treatment plant effluent. Lime is added to unchlorinated effluent. Calcium carbonate forms in the rapid mix, becomes large particles in the slower mixing of the flocculation stage, then settles out in the lime clarification tank. Elevated pH levels from the lime treatment are reduced by adding carbon dioxide, which is acidic. The ballast pond is an equalization basin, taking the surges out of the flow caused by periodic backwashing of filters. A polymer and alum are added to help coagulate remaining solids, then flow is directed through filter media in dual pressure vessles of 0.5 mgd capacity each. Water is pumped to an ion exchange tank where zeolite removes ammonia. The zeolite must be periodically regenerated with a brine solution in a closed-loop stripping tower. A granular activated carbon filtration system, consisting of two carbon contactors with an ozonation chamber in between, removes residual organics. Carbon will be regenerated in a fluidized bed furnace. After the flow leaves the first contactor, 90% is piped directly to disinfection stage, then returned to the system as process water. Remaining 10% of the flow continues to final treatment stages, saving money on size of remaining process equipment. Reverse osmosis unit removes 90% of dissolved solids, aeration strips away dissolved gases and some volatiles, then chlorine dioxide is used as a disinfectant. Some of the resulting water will be tested for chemical composition and health effects on animals. (Baker-FRC)
W83-04099

ADSORPTION OF RADIUM-226 BY BIOLOGICAL ORIGIN ABSORBENTS,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
M. Tsezos, and D. M. Keller.
Biotechnology and Bioengineering, Vol 25, No 1, p 201-215, 1983. 7 Fig, 3 Tab, 22 Ref.

Descriptors: *Adsorption, *Radium, *Radioactive wastes, Biomass, Sludge, Wastewater treatment, Bacteria.

Adsorption of radium-226 from aqueous solutions was studied using waste microbial biomass from fermentation processes and municipal wastewater treatment plants. Radium uptake capacities (nCi per g) at pH 7 for 10, 50, and 300 pCi per ml Ra solutions were: Pseudomonas fluorescens, 0 to 20; Aspergillus niger, 12, 60, and 340; Streptomyces niveus, 32, 130, and 580; industrial sludge, 40, 230, and 1700; Rhizopus arrhizus, 140, 650, and 2000; municipal sludge B, 390, 1900, and 11,000; Penicillium chrysogenum, 450, 2100, and 12,000; municipal sludge A, 700, 5000, and 40,000; Darco S-51 activated carbon, 8, 26, and 120; and Filtrasorb 400 granular activated carbon, 26, 100, and 460. In general maximum uptake was between pH 7 and 10. Uptake was considerably reduced at pH 4 and almost absent at pH 2. (Cassar-FRC)
W83-04114

EFFECTS OF AMMONIA AND PHOSPHATE LIMITATION ON THE ACTIVATED SLUDGE TREATMENT OF CALCIUM-CONTAINING CHEMICAL WASTE,
Shell Development Co., Houston, TX.
J. P. Salanitro, P. T. Sun, and J. B. Thornton.
Biotechnology and Bioengineering, Vol 25, No 2, p 513-523, 1983. 4 Fig, 3 Tab, 20 Ref.

Descriptors: *Nutrients, *Calcium, *Chemical wastewater, Phosphates, Nitrogen, Ammonia, Activated sludge process, Wastewater treatment, Sludge solids, Settling velocity, Sludge volume index, Biomass, Bulking sludge.

The effects of ammonia and phosphate on the activated sludge treatment of a mixed chemical waste containing 1300 mg per liter of soluble Ca were studied in the laboratory. Four runs were made (high ammonia and phosphate, low ammonia and high phosphate, high ammonia and low phosphate, and low ammonia and phosphate). Ammonia levels (mg per liter) were 0.1 and 0.2 for the low treatments and 27 and 42 for the high treatments. Phosphate levels (mg per liter) were 0.1 for the low treatments and 2.4 and 4.2 for the high treatments. COD removal was 89-94%. CaC03 accumulation in biomass solids produced in the low phosphate treatments was 3800-3900 mg per liter

and 1800 mg per liter in the high phosphate treatments. The high-Ca sludges contained crystals of CaC03 and a high percentage of nonfilamentous bacteria; the low-Ca sludges contained filamentous and nonfilamentous bacteria. The high-Ca flocs had polysaccharide contents of 46-62 mg per g volatile suspended solids, sludge volume index of 10-12 ml per g, and settling velocity of 48 ft per hour. The low-Ca flocs had polysaccharide contents of 53-102 mg per g volatile suspended solids, sludge volume index of 60-87 ml per g, and settling velocity of 9-12 ft per hour. (Cassar-FRC)
W83-04115

THE INFLUENCE OF SALT CONCENTRATION ON THE HYDRAULIC PROPERTIES OF ION EXCHANGE RESINS,
Sybron Corp., Birmingham, NJ.
F. X. McGarvey, S. M. Ziarkowski, and B. Kiefer.
AIChE Symposium Series, Vol 78, No 219, p 74-82, 1982. 7 Fig, 13 Tab, 6 Ref.

Descriptors: *Hydraulic properties, *Brines, *Ion exchange, Backwash, Wastewater treatment, Resins, Specific gravity, Fluidized beds.

The hydraulic properties of ion exchange resins in salt solutions (10% and 20%), such as are used in secondary oil recovery, were studied. In a series of Ionac resins with 2% to 12.5% divinylbenzene (DVB) shrinkage was 1.7-49% in 10% salt solution and 5.2-58% in 20% salt solution; greatest shrinkage was in the 2% resin. Specific gravities of 4 mesh size cuts of an 8.5% DVB resin were: 1.2591-1.2789 in water; 1.2909-1.3221 in 10% NaC1; and 1.3265-1.3387 in 20% NaC1. Average C values for pressure drop were: water, 147; 10% salt, 152; and 20% salt, 156. Calculated flows at fluidization onset differed by 0.2-0.3 m per min for the -16+20 mesh size and an order of magnitude less in the other size ranges (-20+30, -30+40, -40+50) in water and salt solution. Bed expansion was greater in 20% brine than in 20% brine or water for a given flow rate. Differences increased with increasing flow rate. (Cassar-FRC)
W83-04132

BIOLOGICAL REGENERATION OF ACTIVATED CARBON,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemical Engineering.
D. A. Wallis, and E. E. Bolton.
AIChE Symposium Series, Vol 78, No 219, p 64-70, 1982. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Activated carbon, *Biological wastewater treatment, *Regeneration, Adsorption, Phenol, Wastewater treatment, Bacteria, Cultures.

The mechanisms of biological regeneration of spent activated carbon used in wastewater treatment were studied using Pseudomonas putida as the degrading microorganism and phenol solutions as indicators of regeneration. Phenol concentration in the feed (300 or 600 mg per liter) did not affect the concentration of adsorbed phenol after regeneration (31-34 mg per g activated carbon) or the % regeneration (49-53%). It was concluded that the microbial culture (1) maintains the solution concentration of phenol at a low level so that substrate desorption from the carbon will occur and (2) converts the phenol to nontoxic substances. The regeneration rate was about 25 mg phenol removed per g carbon per hour for adsorbed phenol concentrations of 40-65 mg phenol per g carbon. At lower concentrations regeneration was about 1 mg phenol per g carbon per hour, reflecting the decrease in the driving force for desorption of the phenol from the carbon as the adsorbed concentration decreased. The maximum extent of regeneration was related to the concentration of phenol in solution, implying that the regeneration rate approaches zero as the adsorbed phenol concentration approaches a state of equilibrium with the solution concentration. Adsorption capacity of the carbon was reduced by (1) carbon-culture contact beyond the maximum regeneration point and (2) multiple adsorption and regeneration cycles. (Cassar-FRC)
W83-04133

UNCERTAINTY ANALYSIS OF A COMPLEX REACTOR SYSTEM USING MONTE CARLO PROCEDURES,
Wayne State Univ., Detroit, MI.
R. H. Kummler, J. G. Frith, and C. -S. Liang.
AIChE Symposium Series, Vol 78, No 220, 36-48, 1982. 15 Fig, 6 Tab, 28 Ref.

Descriptors: *Combined sewer overflows, *Sensitivity analysis, *Model studies, Error analysis, Water quality, Wastewater treatment, Planning, Coliforms, Dissolved oxygen, Alternative planning, Detroit River, Rouge River, Detroit, Michigan, Urban areas, Monte Carlo method, Storm-overflow sewers, Sewer systems.

The combined sever overflow (CSO) system for the Detroit, Michigan, area was modeled, and alternative solutions for water quality problems in the Detroit and Rouge Rivers developed. Simulations included 26 different CSO control options varying from zero to 80 percent of existing overflow volumes. For the best alternative, fecal coliform counts in the Detroit River would be reduced 6-fold (from 240 to 42 per 100 ml) on an annual basis and 2-fold (529 to 252 hours) with respect to number of hours of standard violation. On the Rouge River the fecal coliform counts would be reduced from 1137 to 495 per 100 ml and the hours of violation from 2443 to 1808. It was recommended that no action be taken on the Rouge River section of the system and that several alternatives for the Detroit River section be subjected to cost-benefit analysis. Methods for determining the uncertainty produced by the hundreds of input parameters and the model assumptions included (1) an absolute first order error analysis of the Plume Model of the Detroit River, (2) an intercomparison of independent models of the Rouge River, and (3) a Monte Carlo analysis of the overall set of models. (Cassar-FRC)
W83-04134

THE EFFECT OF WATER PRETREATMENT CHEMICALS ON THE PERFORMANCE AND DURABILITY OF REVERSE OSMOSIS MEMBRANES,
California Univ., Los Angeles. Dept. of Chemical, Nuclear, and Thermal Engineering.
For primary bibliographic entry see Field 3A.
W83-04143

LOW ENERGY FILTRATION USING BUOYANT MEDIA,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
M. J. Semmens, S. Chiesa, P. Brezonik, and Y. Ming-Tang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105477, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Minnesota, St. Paul, August 1983. 35 p, 8 Fig, 39 Ref. OWRT A-046-MINN(1).

Descriptors: *Water treatment, *Wastewater treatment, *Filtration, Solids removal, Effluent polishing, Stormwater treatment, Upflow filtration, Energy, Low energy filtration.

The use of a spherical buoyant media in filtration has many potential advantages. The media stratify during backwashing such that the largest spheres are at the top of the bed and the smallest are at the bottom. During upflow filtration solids may be removed by both straining on the underside of the filter and by depth filtration. The accumulated solids may be readily dislodged by a brief downflow backwash and gravity assists in this cleaning process. Basic studies on the removal of coagulated clay suspensions indicated that the clay was removed throughout the depth (D.3m) of the filter for media sizes between 0.6 and 1.0 mm. Straining was not observed to be significant but it would become more important for smaller media sizes or more flocculant solids. Headloss development was monitored and followed the expected behavior for depth filtration. Low headlosses could be maintained by using shallow bed of media and backwashing frequently. These preliminary studies indicate that if the buoyant media are to be used in an effective low energy filter, the system design will be very important. A straining mechanism may be preferred since the solids are retained on the underside of the filter and gravity will assist in cleaning the bed during backwash. However, to avoid rapid headloss development depth filtration must be used also. Additional studies are needed to characterize the backwashing behavior of the media and to identify the best operating strategies for long-term use.
W83-04149

TREATMENT OF RECYCLE STREAMS FROM THERMAL SLUDGE CONDITIONING,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
R. R. Dague.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105592, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report No 121, Iowa State Univ., Ames, March 1983. 43 p, 17 Fig, 6 Tab, 26 Ref. OWRT A-073-IA(1), 14-34-0001-0117.

Descriptors: *Biological wastewater treatment, *Biological filter, Anaerobic bacteria, Wastewater treatment, *Sludge conditioning, *Thermal sludge, *Iowa, Anaerobic filter, Sludge treatment.

The thermal conditioning and dewatering of activated sludges in wastewater treatment plants results in decant and filtrate streams that are high in organic matter. Although the volume of the recycle flow is small, the high strength may add as much as 20% or more to the total organic load on the treatment plant. The purpose of this research was to evaluate the impact of the recycle of the high-strength waste streams on plant performance in terms of increased oxygen consumption and sludge production, and to determine the effectiveness of the anaerobic filter in treating the recycle flow from thermal sludge conditioning. Thermal conditioning wastes from Dubuque, Iowa, had an average 5-day BOD of 9,600 mg/L and a Bd exertion rate of 0.2063 per day (base 10). This indicates an ultimate to 5-day BOD ratio of 1.1. The application of the anaerobic filter to the Dubuque thermal conditioning wastes indicated that a 20-day BOD removal of 84% could be achieved with a filter eight feet in depth and loaded at a nominal 200 lb of BOD sub 20/1000 cu ft of filter volume. When applied to the thermal conditioning wastes from Cedar Rapids, Iowa, similar results were obtained. The recycle of thermal conditioning wastes at Dubuque increased the BOD sub 5 load on the plant by 20.0% of the total plant influent BOD sub 5. Treatment of the thermal conditioning liquor with an anaerobic filter to an 85% BOD sub 20 removal level would reduce this increase to only three percent. It is concluded that the anaerobic filter is an effective way of treating the high strength waste from thermal conditioning processes, resulting in significant reductions in oxygen consumption and excess sludge production in activated sludge wastewater treatment plants.
W83-04161

TREATABILITY STUDIES ON LEACHATE FROM A CO-DISPOSAL LANDFILL,
Cleanaway Ltd., Rayleigh (England).
K. Knox.
Environmental Pollution, Series B, Vol 5, No 3, p 157-174, 1983. 7 Tab, 9 Ref.

Descriptors: *Leachates, Ammonia, *Biological treatment, Organic carbon, *Landfills, *Waste disposal, *Aerobic treatment, Industrial wastes, Hazardous materials, Nitrification, Fermentation, Activated carbon, Color, Waste dumps, Lime, *England, South Essex, *Wastewater treatment.

Characteristics of leachate from the Pitsea landfill, a major co-disposal site in South Essex, England, are presented. The leachate typifies a stabilized situation where acid fermentation is in balance with methane formation. No hazardous wastes were detected in the leachate. Although aerobic biological treatment was capable of completely nitrifying the ammonia in the leachate, it was unable to effectively remove organic carbon. Lime

treatment removed a high proportion of the colored compounds from the leachate, but only 20% of the organic carbon. Powdered activated carbon removed both color and organic carbon. The removal of total organic carbon conformed to a Freundlich-type isotherm. Toxicity tests showed that ammonia was the only toxic substance in the leachate requiring removal. Conventional biological methods were sufficient to treat the landfill leachate. (Geiger-FRC)
W83-04172

FACTORS AFFECTING THE CLARIFICATION PERFORMANCE OF ACTIVATED SLUDGE FINAL SETTLERS,
Chulalongkorn Univ., Bangkok (Thailand). Dept. of Sanitary Engineering.
M. Tuntoolavest, E. Miller, and C. P. L. Grady, Jr.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 234-248, March, 1983. 7 Fig, 7 Tab, 23 Ref.

Descriptors: *Wastewater treatment, *Clarification, Clarifiers, Aeration basins, Wastewater treatment facilities, Sludge, *Activated sludge processes, *Settlers, Design criteria, Quality control.

Factors which affect the clarification performance of pilot plant settlers were examined. Of the three operational variables studied, mixed liquor suspended solids concentration (MLSS), air flow rate, and sludge recycle ratio, the MLSS concentration had the strongest effect on the effluent suspended solids concentration. Effluent quality deteriorated as the MLSS concentration increased, confirming the results of an earlier study by Pflanz. The other operational variables exerted less significant effects on the effluent suspended solids concentration, although the turbulence level caused the greater effect of the two and there was a complex interaction between them. Because of the complex interaction between the sludge recycle ratio and the turbulence level, the MLSS concentration is the only easily manipulated control variable available for short-term control of the effluent suspended solids concentration. These findings were consistent with the concept that floc breakup predominates over floc formation in an activated sludge aeration chamber. The quality of effluent leaving an activated sludge settler is determined largely by the amount of dispersed solids entering the settler. The effects of settler overflow rate and retention time were of about the same magnitude, although both had less effect than the MLSS concentration. Because of the effects of MLSS concentration and turbulence level on the concentration of suspended solids in the effluent from an activated sludge settler, it is likely that least-cost designs will call for low MLSS concentrations and large aeration basins. (Baker-FRC)
W83-04177

HEAT RECOVERY, FLOW EQUALIZATION, AND ALTERNATE DISCHARGE HIGHLIGHT AWT EXPANSION,
Black and Veatch, Denver, CO.
G. F. Shimp, G. E. Berg, S. A. Swanson, and G. Brown.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 249-254, March, 1983. 6 Fig.

Descriptors: *Wastewater treatment facilities, *Design criteria, *Advanced wastewater treatment, Breckenridge Sanitation District, Water quality control, Flow, Colorado, Phosphorus removal, *Heat exchangers.

The series of management actions and facility improvements that enabled the Breckenridge Sanitation District to maintain compliance with water quality standards while providing for continued growth in its service area are described. Specific goals in developing the plant expansion design included making maximum practical use of the facilities in the existing treatment plant; improving process stability and overall plant operability; improving treatment performance in critical areas; providing improved sludge stabilization and processing facilities consistent with the countywide sludge management plan; and improving the energy efficiency of the treatment operation, where practical. Unique features involved in the expansion of the advanced wastewater treatment plant which were necessitated due to site-specific problems included the accomplishment of flow equalization inline without pumping, aeration, or mixing. New facilities were to be selectively incorporated into the treatment train to achieve maximum use of existing facilities. Common-wall construction and covered basins will be used where possible in the new treatment additions to reduce building heating requirements. A heat pipe heat exchanger will be used to recover heat from the aerobic digesters, and the plant's discharge will be relocated to avoid an ammonia toxicity problem. (Baker-FRC)
W83-04178

NITRIFICATION FACILITIES START-UP AND INITIAL OPERATION,
District of Columbia Dept. of Environmental Services, Washington. Wastewater Div.
W. F. Bailey, J. D. Bonomo, and E. R. Jones.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 221-228, March, 1983. 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Wastewater treatment facilities, *Nitrification, Wastewater treatment, Economic aspects, Aeration, Biochemical oxygen demand, Nitrogen, Kjeldahl nitrogen, Phosphorus, District of Columbia, *Advanced wastewater treatment.

Expansion of the District of Columbia's wastewater treatment plant at Blue Plains has been underway since 1970. At a cost of over $450 million, the plant was upgraded from a modified aeration secondary treatment plant to an advanced wastewater treatment facility capable of achieving over 95% removal of suspended solids, 5-day biochemical oxygen demand, total Kjeldahl nitrogen, and total phosphorus. The systematic training and start-up efforts required to place this large, complex facility in service are discussed. The first year's operating and process control data for the nitrification system are presented. The systematic approach contained several elements, starting with the division of the overall start-up into numerous manageable task groups, then proceeding with work on each group simultaneously. A start-up coordinating committee was formed to oversee the overall program, ensuring that all activities were complete. Along with other tasks this committee planned and implemented a comprehensive and site-specific training program during the start-up of a major process at an existing wastewater treatment facility. After an initial period of satisfactory operation, the nitrification process became upset, with decreased settleability and TKN removal. This was followed by improved performance and compliance with effluent quality requirements, indicating that reduction of nitrification rate may occur as the influent BOD5:TKN ratio is increased; the mean alkalinity destroyed:TKN removal for the entire year was 5.3 g/g, which was significantly lower than the theoretical value; and the nitrification rate and system stress data may be used effectively for process control, particularly when coupled with other measurements of mixed liquor quality. As stress increased above the maximum level, effluent TKN concentration increased sharply. (Baker-FRC)
W83-04179

TEMPERATURE EFFECTS ON OXYGEN TRANSFER TO ROTATING BIOLOGICAL CONTACTORS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, R. Suozzo, and B. R. Romero.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 270-277, March, 1983. 9 Fig, 2 Tab, 21 Ref.

Descriptors: *Rotating biological contactors, *Temperature effects, *Wastewater treatment, Oxygen transfer, Oxygen, Biochemical oxygen demand, Nitrification, Denitrification, Methanogenesis.

Successful scale-up or transfer of rotating biological contactors (RBCs) technology from pilot scale to full scale, from one wastewater to another, and from one loading condition to a second loading condition requires an understanding of the rate-controlling mechanism. A laboratory scale RBC, in which nine flat disks of 50 cm diameter rotate in a basin of water, was constructed from polymethyl methacrylate. For certain experiments, the disks were not rotated. Instead, a propeller-mixer was inserted into the basin and used to produced a mixing pattern in the basin without withdrawing a liquid film on the disks. These mixer experiments allowed determination of the mass transfer produced solely by agitating the surface of the liquid in the basin. It was noted that as the rotation speed was increased, the overall mass transfer coefficient was increasingly dominated by oxygen transfer via the liquid film that adhered to the rotating disks. For the typical tip speed used in practice, 20 m/min, the film transfer was responsible for about 75% of the total oxygen transfer for the laboratory scale unit. The temperature correction factor was not a constant. Temperature did affect the dominant mechanism. Higher temperatures produced slightly higher temperature-correction factor values because direct transfer became more dominant. The overall oxygen transfer rates were lower at higher temperature than at low temperature. Analysis of the oxygen-transfer mechanisms leads to the prediction that larger units will have a lower oxygen transfer rate than a smaller unit having the same tip speed and specific surface area. (Baker-FRC)
W83-04181

BACTERIAL DIE-OFF KINETICS IN WASTE STABILIZATION PONDS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert, M. G. Dissanayake, and N. C. Thanh.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 285-296, March, 1983. 7 Fig, 6 Tab, 32 Ref.

Descriptors: *Stabilization ponds, *Wastewater treatment, *Bacteria, *Kinetics, Mathematical equations, Temperature effects, Algae, Model studies, Brazil.

Waste stabilization ponds (WSP) are becoming popular for treating wastewater, particularly in tropical and subtropical regions where there is normally and abundance of sunshine, and the ambient temperature is high. A research program was undertaken to develop mathematical relationships of the baterial die-off in WSP incorporating two proposed models, one for the algal concentration Cs and the other for the bacterial die-off rate coefficient. A multiple linear regression equation was developed to relate the bacterial die-off rate coefficient, k, to other parameters. This equation can be extended to predict the k values of other baterial species by the introduction off the species coefficients into the regression coefficient. The non-ideal flow equation of Wehner and Wilhelm was proposed for the prediction of the bacterial survival ratio in WSP. Besides the k value, this equation accounts for the pond dispersion factor, d, and the actual hydraulic detention time. The Wehner and Wilhelm equation yielded better results in predicting bacterial die-off in WSP than the first-order rate equation. This is probably because the former includes other important parameters influencing pond performance and bacterial die-off. Verification of the model responses was made with data of the full scale WSP and some ponds in northeast Brazil. Sensitivity analyses were carried out to show the effect that changes in magnitude of these influential parameters had upon the k values and the bacterial survival ratio. (Baker-FRC)
W83-04182

VELOCITY AND SUSPENDED SOLIDS DISTRIBUTION IN SETTLING TANKS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
A. Joo-Hwa Tay, and G. W. Heinke.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 261-269, March, 1983. 12 Fig, 6 Tab, 17 Ref.

Descriptors: *Wastewater treatment, *Suspended solids, *Settling tanks, *Settling velocity, Hydraulic loading, Phosphorus removal.

Data and analysis and presented on measurements of velocity and suspended solids concentrations inside two primary settling tanks and one pilot plant. The plants were operated at varying rates of hydraulic loading with and without the addition of chemicals of phosphorus removal. The investigations covered a period of 3 years. Velocity measurements inside a settling tank were deemed to be useful tools in predicting the reduction of suspended solids in a settling tank. An instrument that allows velocity measurements in three directions, and down to a few millimeters per second, is required. Local velocities are the main factor influencing the settling of physical or physical-chemical flocs. For raw domestic wastewater, velocities should be kept below 15 mm/sec to achieve about 50% removal suspended solids. The influence of increasing flow rates, resulting in correspondingly higher velocities, on the reduction of suspended solids is greater for raw wastewater than for chemically treated wastewater, particularly when polymers are used. For the settling tanks studied, maximum velocities generally occurred between a 0.4 and 0.8 fraction of the depth of the tank. For each tank the velocity profile pattern did not change significantly with increasing flow rate, although the magnitude did of course increase. A mathematical model was developed, through modification of an existing model used in air pollution studies, which allows the prediction of suspended solids levels in the tanks. This may be useful in the future. (Baker-FRC)
W83-04183

INACTIVATION OF SALMONELLA DURING ANEROBIC DIGESTION OF SEWAGE SLUDGE,
Water Research Centre, Stevenage (England).
E. G. Carrington, S. A. Harman, and E. B. Pike.
Journal of Applied Bacteriology, Vol 53, No 3. p 331-334, 1982. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Salmonella, *Anaerobic digestion, *Kinetics, Digested sludge, Digestion, Sludge digestion, Sewage bacteria, Retention time, Temperature.

The inactivation of Salmonella duesseldorf in sewage sludge during anaerobic digestion of spiked raw sewage sludge was studied at 35 and 48 degrees with mean retention periods between 10 and 20 days. Specific rates of decay were greater at the higher temperature for the same retention times and similar for retention periods greater than 15 days but lower for 10 day retention periods. The rates of decay were greater when levels of Salmonella in the feed were lower. Gas production, an indicator of the steady state, was reduced with a mean retention period of 6.7 days. When a single dose of the bacterium was added to the digesting sludge, the inactivation period appeared to follow first-order kinetics at 35 degrees, and the decimal decay rate was similar to that in the daily feeding regime with larger and similar inocula levels. At 48 degrees, the rate of inactivation decreased with decreasing time from inoculation, suggesting that cells of different thermal resistance were present in the culture. Rates and degrees of inactivation in such experiments are greater than in full-scale digesters because the indigenous Salmonellae of the latter are more resistant and conditions are seldom ideal for inactivation. (Geiger-FRC)
W83-04184

EFFECT OF DIFFUSIONAL RESISTANCES ON THE PERFORMANCE OF SUBSTRATE INHIBITED IMMOBILIZED ENZYMATIC CFSTR SYSTEMS,
University of Petroleum and Minerals, Dhahran (Saudi Arabia).
S. Ilias, S. A. Beg, and M. M. Hassan.
Journal of Environmental Science and Health, Part A, Vol 18, No 2, p 311-326, 1983. 6 Fig, 28 Ref.

Descriptors: *Mathematical models, *Wastewater treatment, *Enzymes, *Diffusion coefficient, *Membrane processes, Model studies, Flow resistance, Mathematical studies.

Recent developments in large scale enzyme purification have resulted in the development of various techniques for the immobilization of enzymes for application in industry, medicine and waste treatment. A single particle diffusion model is presented for estimating an effectiveness factor for a substrate inhibited encapsulated immobilized enzyme particle of spherical shape. The model takes into account both internal and external diffusional resistances and may be applied to the performance of a continuous flow stirred tank reactor (CFSTR) system. The effects of membrane thickness, Sherwood Number, dimensionless inhibitor constant, characteristic CFSTR-encapsulated enzyme particle parameter, and the ratio of the substrate diffusion coefficients on the substrate conversion are studied parametically. Numerical results are given for a range of variables of practical importance. (Geiger-FRC)
W83-04187

OPTIMISED AEROBIC AND THERMOPHILIC TREATMENT OF MUNICIPAL SEWAGE SLUDGES AND NIGHT SOILS IN A CONTINUOUS OPERATION,
PLM Resource Recovery Div., Malmo (Sweden).
C. -G. H. Carlson.
Journal of Chemical Technology and Biotechnology, Vol 32, No 11, p 1010-1015, 1982. 6 Fig, 2 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Aerobic digestion, *Biodegradation, *Aeration, *Optimization, Sludge drying, Digestion, Sludge digestion, Digested sludge, Biological oxygen demand, Mixing.

Aerobic and thermophilic (57 degrees) biodegradation and stabilization processes were applied to a thick homogenized feed of 5-7% dry solids from raw and partly digested municipal sludges and night soils at a commercial wastewater treatment center. Kinetic data for biodegradation were optimized with respect to mixing and aeration. Graphs were generated, from which optimal retention time and other process stage parameters were calculated to achieve a BOD7 reduction of 85%. The prime feeds for raw and partially digested sludges were 10-15% for dried solids (DS) in a pH range of 6.5-7.2 at a BOD7 of 35-52 g/kilogram. For night soils and feces, the prime feeds were 1-2% DS in a pH range of 6.7-7.4 at a BOD7 of 6.5-14 g/kilogram. Costs for BOD removal in the optimized process are less than with conventional techniques for waste and sludge treatment, and the enzyme treated dewatered effluents are acceptable for land infiltration. (Geiger-FRC)
W83-04198

5E. Ultimate Disposal Of Wastes

COAL CONVERSION SOLID WASTE DISPOSAL,
Oak Ridge National Lab., TN.
C. W. Francis, W. J. Boegly, Jr., R. R. Turner, and E. C. Davis.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1301-1311, December, 1982. 2 Fig, 4 Tab, 13 Ref.

Descriptors: *Solid waste disposal, *Land disposal, *Landfills, *Leachates, *Coal gasification, *Fly ash, Solid wastes, Industrial wastes, Hazardous materials, Groundwater pollution, Sulfates, Water pollution sources.

Extensive characterization and leaching studies were carried out on ash slags generated in bench scale operations, pilot plants, and/or process development units for eight different gasification processes to assess the consequences of disposal in landfills. None of the eight wastes exceeded the United States Environmental Protection Agency's toxicity limits set forth in the Resource Conservation and Recovery Act of 1976, and they were therefore classified as nonhazardous wastes. Concentrations of polynuclear aromatic hydrocarbons in the aqueous leachates of selected ash slags were less than 1 microgram/gram and posed no significant environmental threat. For wastes containing sulfur concentrations of 0.3-4%, column elution studies produced effluents with pH values less than 3 and sulfate concentrations greater than 10,000 milligrams/liter. Therefore the major environmental impact associated with the land disposal of these ash slag wastes may be the dissolution of sulfates and the potential acidification of groundwaters. (Geiger-FRC)
W83-03858

DECOMPOSITION OF SOLID WASTE IN TEST LYSIMETERS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
R. K. Ham, and T. J. Bookter.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1147-1170, December, 1982. 8 Fig, 4 Tab, 3 Ref.

Descriptors: *Lysimeters, *Land disposal, *Landfills, *Leaching, *Solid waste disposal, Waste disposal, Leachates, Evapotranspiration, Chemical oxygen demand, Methane, Municipal wastes, Runoff rates, Water pollution sources.

Eight lysimeters designed to test the effects of refuse shredding, soil cover, and lift thickness were filled with 100 or 200 tons of residential and light commercial solid wastes and were monitored for seven years for leachate and runoff rates, gas and leachate composition, and refuse temperature and surface settlement. With soil cover, more runoff but less evapotranspiration was observed, so that leachate rates were about the same with or without soil cover. When landfilled under similar conditions, shredded refuse produced higher peak concentrations of matter in leachate than unprocessed refuse. Without soil cover, leachate strengths declined rapidly after reaching peak concentrations, with the result that shredded refuse without cover produced less chemical oxygen demand (COD) than either shredded or unprocessed covered refuse. Doubling the refuse depth nearly doubled the leachate COD levels, but greatly increased the stabilization time needed to attain low COD levels. Placement of a second lift of refuse over a relatively well stabilized first lift reduced COD produced by the second lift by 75-99%. Two cells without soil cover and with unprocessed refuse had lower leachate containment and lower methane gas levels, but presented problems with odor, flies and rodents. (Geiger-FRC)
W83-03861

EFFECT OF SEWAGE SLUDGE ON TRACE ELEMENT MOBILITY IN SOILS,
Institute for Soil Fertility, Groningen (Netherlands). Dept. of Soil Biology.
For primary bibliographic entry see Field 5B.
W83-03893

HEAVY METAL CONCENTRATIONS IN EARTHWORMS FROM SOIL AMENDED WITH SEWAGE SLUDGE,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
For primary bibliographic entry see Field 5B.
W83-03897

NITROGEN AND PHOSPHORUS MOVEMENT IN COMPOST-AMENDED SOILS,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W83-03898

EFFECTS ON SOILS AND VEGETATION OF PLANT NUTRIENTS AND HEAVY METALS FROM WASTEWATER-TREATMENT-PLANT SLUDGES DISPOSED ON LAND,
West Virginia Univ., Morgantown. Water Research Inst.
D. J. Horvath, R. F. Keefer, and R. N. Singh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255463, Price codes: A06 in paper copy, A01 in microfiche.

Completion Report August 1983. 123 p, 9 Fig, 68 Tab, 77 Ref, 1 Append. OWRT A-025-WVA(3), 14-34-0001-7104.

Descriptors: *Environmental effects, Food chains, Heavy metals, *Land disposal, *Nutrients, *Phytoxicity, *Sludge disposal, Soil contamination, Trace elements, *Waste disposal, *Water pollution sources, Cadmium, Chromium, Ecology, Nickel, Nitrogen, Path of pollutants, Phosphorus, Plant growth substances, Toxicity, Wastewater disposal, Wastewater pollution, *West Virginia.

Sludges and effluents from wastewater-treatment-plants in West Virginia cities were analyzed chemically for fourteen elements. By greenhouse and field applications to corn and soybean crops, sludges were evaluated for effectiveness in providing plant nutrients and in introducing heavy metals into the food chain. Effluents contained a higher proportion than sludges of the elements except iron, copper, zinc, and lead. Plant nutrients, especially nitrogen and phosphorus, occurred in amounts beneficial to plant growth. Toxic manganese levels in soils were reduced by sludge application. No toxocity or undesirably high levels of copper, zinc, chromium, nickel, or lead were found, but cadmium was increased sufficiently to cause concern. Use of lime and phosphorus fertilizer retarded heavy-metal absorption by the crop plants. Nutrients and heavy metals were restricted to upper soil horizons. Except for nickel, heavy metals did not accumulate in plant tissues unless sludge-application rates were very high. Soybean tissues at one site absorbed nickel from a sludge not extraordinarily high in nickel but not from another sludge extremely high in nickel. The sludges caused no evident phytoxicity. Cadmium is the only one of these elements that could cause alarm by accumulating to toxic levels in plants grown on sludge-amended soils.
W83-03905

AN ANALYTICAL MODEL OF CONTAMINANT MIGRATION IN SHALLOW AQUIFERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-03909

AGRICULTURAL DISPOSAL OF SLUDGES ON A HISTORIC SLUDGE DISPOSAL SITE,
Severn-Trent Water Authority (England). Lower Trent Div.
H. Rundle, M. Calcroft, and C. Holt.
Water Pollution Control, Vol 81, No 5, p 619-632, 1982. 4 Fig, 17 Tab, 21 Ref.

Descriptors: *Sludge disposal, *Metals, *Land application, Fate of pollutants, Cadmium, Zinc, Heavy metals, Land disposal, Stoke Bardolph Estate, Nottingham, *United Kingdom, Arming.

Sewage and sludge have been applied to the 800 ha Stoke Bardolph estate near Nottingham, England, since 1880. Results of a soil survey performed in 1977 showed that Zn levels are greater than the ADAS recommended 250 mg per kg limit on 100% of the estate. The ADAS levels are exceeded for Cd on 71% of the area, for Cr on 35% of the area, and for Pb on 4% of the area. An 8 ha section has very high heavy metals concentrations (8000 mg per kg Zn and 45 mg per kg Cd), a result of disposal of sludges from insufficiently treated industrial effluents. Zn and Cd levels projected for the year 2014, assuming the present rates of sludge application, would rise to maxima of 11,000 mg per kg Zn and 65 mg per kg Cd. The total area exceeding the ADAS recommended levels is expected to increase slightly. This farm currently grows grass, maize, cereals, and dairy cattle. Levels of heavy metals and nitrates are regularly monitored to prevent sale and consumption of products too high in toxic substances. It was estimated that 540 kg per year of Cd is applied in sludge. Of this, 6.4 g per year may enter the human food chain. (Cassar-FRC)
W83-03945

RE-USE OF SLUDGES AND TREATED WASTE WATER IN AGRICULTURE. (TROUBLES ARISING FROM THE CONTAMINATION OF SOILS WITH HEAVY METALS AND FROM APPLICATION OF SLUDGES AND TREATED WASTE WATER IN AGRICULTURE),
Biologische Bundesanstalt fuer Land- und Forstwirtschaft, Berlin (Germany, F.R.). Inst. for Non-Parasitic Plant Diseases.
A. Kloke.
Water Science and Technology, Vol 14, No 12, p 61-72, 1982. 3 Fig, 6 Tab, 10 Ref.

Descriptors: *Fate of pollutants, *Land application, *Sludge disposal, Sludge, Agriculture, *Heavy metals, Cadmium, Lead, Mercury, Plants, Uptake, Guidelines, *Federal Republic of Germany, *Treated water.

Since plants, including those used for food, take up and accumulate increasing amounts of heavy metals with increasing amounts of these hazardous elements in the soil, it is necessary to establish tolerable amounts of heavy metals in soil. In order to determine what is safe and what is hazardous in the line of tolerable amounts of heavy metals in foodstuffs, one must note the toxicological considerations of the FAO/WHO Expert Committee on Food Additives, presented in 1972. This group set forth recommended preliminary amounts for tolerable weekly intake of lead, cadmium, and mercury. These are used as starting points of consideration and calculation for the upper limits of these elements in individual foodstuffs, including plants. Heavy metals enter the soil through different routes and are slowly accumulated there. If the input of pollutants is stopped their concentration in soil does not decrease. The heavy metals contents of plants depend not only on the amount present in soil but also on the plant species. Analysis of heavy metals in soil and plants is tedious and time-consuming, and large mean errors are common. Studies of potential harm to future generations are underway in the Federal Republic of Germany in order to establish limits to the amounts of sludge or wastewater which may be disposed of by land application. Tentative limits have been established by the German government for heavy metals in soils and sludges, ranging from 3000 mg/kg dry matter in sludge and 300 mg/kg in soil for zinc to 25 and 2 mg/kg, respectively, for mercury. Once the corresponding soil level has been reached, land application must cease. (Baker-FRC)
W83-03970

COMPARATIVE MOVEMENT OF DIFFERENT ENTEROVIRUSES IN SOIL COLUMNS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 5B.
W83-03984

IRRIGATION WITH SIMULATED SECONDARY WASTE WATER ON TILED SOIL CROPPED TO BROMEGRASS AND CORN,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 3C.
W83-03985

DISPOSAL OF FEEDLOT-LAGOON WATER BY IRRIGATING BROMEGRASS: II. SOIL ACCUMULATION AND LEACHING OF NITROGEN,
Kansas Agricultural Experiment Station, Manhattan. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W83-03986

MINERALOGICAL CONTROLS ON TOXIC ELEMENT CONTAMINATION OF GROUNDWATER FROM BURIED ELECTRICAL UTILITY SOLID WASTES: I. SOLID WASTE MINERALOGY II. LITERATURE REVIEW OF FLY ASH MINERALOGY,
North Dakota State Univ., Fargo.
For primary bibliographic entry see Field 5B.
W83-04004

FLOW OF KAOLINITE AND SEWAGE SUSPENSIONS IN SAND AND SAND-SILT: I. ACCUMULATION OF SUSPENSION PARTICLES,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
R. L. Uebler, and D. Swartzendruber.
Soil Science Society of America Journal, Vol 46, No 2, p 239-244, March/April, 1982. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Clogging, *Filtration, Suspended solids, Mathematical equations, *Kaolinite, *Sand, Silt, Laboratory studies, *Waste disposal, Land disposal.

Following application of laboratory sewage and kaolinite suspensions, the contents of water and accumulated suspension solids were measured both nondestructively and simultaneously at highly localized positions in vertical columns of sand and sand-silt using the dual-energy gamma-ray apparatus of Nofziger and Swartzendruber. The results were compared with a proposed mathematical description of the clogging process. The attenuation technique was successful for measuring the kaolinite bulk density but was of limited value for determining the sewage-solid bulk density. By postulating mechanism of suspension particle entrapment within the porous medium, an exponential equation was derived to describe the accumulation of suspension particles with time at a fixed position. The constants in this equation were determined from the experimental data by nonlinear least-squares regression and appeared to offer promise for characterizing the kaolinite accumulation in the sand and sand-silt. In general, the maximum accumulation of kaolinite occurred in the several millimeters nearest the suspension application surface. The initial water content had little effect on Kaolinite accumulation in the sand-silt. A depth of penetration to about 16 cm was detected in the initially air-dry sand; the maximum accumulations were larger than in the sand-silt but required much more time to attain. (Baker-FRC)
W83-04068

FLOW OF KAOLINITE AND SEWAGE SUSPENSIONS IN SAND AND SAND-SILT: II. HYDRAULIC CONDUCTIVITY REDUCTION,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
D. Swartzendruber, and R. L. Uebler.
Soil Science Society of America Journal, Vol 46, No 5, p 912-916, September/October, 1982. 6 Fig, 1 Tab, 14 Ref.

Descriptors: Flow, Permeability coefficient, Soil water, *Solute transport, *Kaolinite, Sewage, Land disposal, *Sludge disposal, *Sand, *Silt, Clogging, Filtration, Mathematical equations.

The reduction of hydraulic conductivity during the flow of kaolinite and sewage suspensions was analyzed. A theoretical equation for hydraulic conductivity behavior was derived, and was confirmed by laboratory experiments with sewage effluent and kaolinite suspension flowing through columns of sand and sand-silt. In the equation hydraulic conductivity is expressed as an exponential function of the cumulative volume of suspension inflow; the equation contains a characterizing constant, termed the clogging coefficient, which is zero when water alone is the flow liquid. The equation was verified by experimental measurements. For a given suspension, the clogging coefficient was larger for sand-silt than for sand; that of a given porous medium was larger for kaolinite suspension than for sewage suspension, but was not significantly affected by the initial water content (air-dry or satiated) of the porous medium. The clogging coefficient offers promise as a criterion for the design of land application sewage systems and as a parameter for describing soil crusting caused by the infiltration of muddy water. (Baker-FRC)
W83-04069

EPA'S NEW LAND DISPOSAL RULES-A CLOSER LOOK,
A. Morrison.
Civil Engineering (New York), Vol 53, No 1, p 44-49, 1983. 5 Fig.

Descriptors: *Waste disposal, *Regulations, *Groundwater protection, Groundwater contamination, Monitoring, Leachates, Hazardous wastes, Land disposal, Waste dumps, Waste Storage, Environmental Protection Agency, Linings.

The new land disposal rules of the EPA represent a two-pronged approach: design and operating standards intended to minimize leachate generation in the facility and leakage out of it; and a groundwater monitoring and remedial response program to detect and clean up any ground water contamination. The rules call for broad use of groundwater monitoring to detect leaks, in most cases after a plume of leachate has entered the groundwater. Four types of facilities are covered in the regulations: landfills, surface impoundments, waste piles, and land treatment units. Major features of the regulations include: a synthetic membrane liner and a leachate collection and removal system for new landfills; new surface impoundments and waste piles must install a liner which may be synthetic or clay; the groundwater monitoring and response requirements established a three-tiered program to detect, evaluate and correct groundwater contamination during the active life of the unit; existing portions of landfills, impoundments, and waste piles are exempt from the liner and leachate collection requirements, facilities with two synthetic liners are exempt from the groundwater monitoring requirement; any facility closed without first removing or decontaminating a hazardous material must have a final cover or cap; and variances from the liner and leachate collection rules will be allowed if the owner/operator can prove to EPA that wastes will never escape the unit. (Baker-FRC)
W83-04100

LINING A POND TO CONTAIN URANIUM TAILINGS,
R. D. Baldwin.
Civil Engineering (New York), Vol 53, No 1, p 77-79, 1983. 1 Fig.

Descriptors: *Waste storage, *Ponds, Evaporation, Uranium, Sulfuric acid, Hazardous wastes, Linings.

Impermeable pond linings combined with fabric underlinings are a recent innovation in industrial storage pond construction. In 1980 three such ponds were built to provide 71 acres for effluent storage and evaporation at a uranium mill. The process of refining uranium ore into the industry standard yellowcake requires use of sulfuric acid as leaching agent. The stored waste material therefore contains both spent sulfuric acid and some uranium in solution. This pond lining effectively contained the liquid and protected the groundwater supplies below. Evaporation leaves a more concentrated solution which is then recycled for some additional recovery of uranium values. The latest ponds at the Anaconda site have no layer of earth on top of the pond liner. Without this earth layer the liner can be inspected routinely and repairs performed when needed. One method of eliminating wave action problems encountered in storage ponds has been to use smaller ponds as wave action is proportional to the reach across the pond. The liner itself which has been used is a three ply laminated industrial grade reinforced Hypalon produced by duPont. Two calendered 15 mil thicknesses of Hypalon encapsulate one layer of high strength polyester woven fabric scrim to produce a single nominal 36 mil thickness laminated product. Fibretex was used as a geotextile underlining. Properly installed it is unaffected by ultraviolet light, acids, alkalies,oils and most chemical solvents. It resists tearing, puncture and abrasion. Filling the new ponds began eleven months after the start of the project. The cost was $60,000 per acre, including earthwork, Fibretex, Hypalon, installation, testing and quality control. (Baker-FRC)
W83-04101

TREATABILITY STUDIES ON LEACHATE FROM A CO-DISPOSAL LANDFILL,
Cleanaway Ltd., Rayleigh (England).
For primary bibliographic entry see Field 5D.
W83-04172

PHYSICAL DESIGN OF OVERLAND FLOW SYSTEMS,
California Univ., Davis. Dept. of Civil Engineering.
R. G. Smith, and E. D. Schroeder.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 255-260, March, 1983. 5 Fig, 21 Ref.

Descriptors: Wastewater treatment, *Overland flow, *Land application, Land disposal, *Wastewater disposal, *Design criteria.

Overland flow processes are rapidly gaining acceptance for the treatment and disposal of municipal wastewaters. This paper reviews problems and suggests solutions along with design criteria currently in vogue for physical components of such systems. Physical design considerations must examine slope grade, slope length, distribution systems available, top of slope systems, distributed application systems, and runoff collection systems. Overland flow processes can provide inexpensive solutions to municipal wastewater treatment problems. Problems observed in systems now operating result in lower than expected effluent quality and higher than predicted maintenance costs. Significant design problems can be caused by viewing these complex processes as simple or as similar to temporary agricultural irrigation systems. (Baker-FRC)
W83-04180

SLUDGE RECYCLE AND REUSE IN ACID MINE DRAINAGE TREATMENT,
Nebraska Univ. at Omaha. Dept. of Civil Engineering.
G. B. Keefer, and W. A. Sack.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 278-284, March, 1983. 3 Fig, 11 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Sludge disposal, *Acid mine drainage, *Activated sludge process, Ferric sulfate, Sulfates, Iron.

The production of acid mine drainage and the associated waste sludge produced from lime neutralization of AMD are increasing in the Appalachian region. Research was undertaken to make more efficient use of the lime used in the AMD neutralization process; to investigate recovery of the iron in the AMDS for use as a coagulant; to reduce the ultimate volume of the AMDS sludge impounded in lagoons; and to determine the effectiveness of the coagulent prepared from the AMDS. Recycling of the sludge in the AMD neutralization process reduced lime requirements 31% for the waste tested in the laboratory. When costs for the additional equipment needed to use this process were compared to the savings from lower lime usage, the process was cost effective. Recovery of the iron from the recycle process sludge required 25% less acid than did the sludge produced from conventional treatment. If a particular AMD treatment plant were to be built with the intention of using the waste sludge as a coagulant, this lower acid requirement would also represent a cost savings. Simply by using the sludge as a coagulant, the land requirements for AMDS storage could be reduced. When used as a coagulant the acidified AMDS performed as well as stock ferric sulfate. It was found that virtually all of the sulfate present in the coagulant exists in the wastewater effluent. However, the effluent concentrations were generally in the 200 mg/liter range, which should pose little problem. (Baker-FRC)
W83-04200

5F. Water Treatment and Quality Alteration

FACTORS AFFECTING THE CATALYTIC AND PHOTOLYTIC ENHANCEMENT OF OZONIZATION IN WATER SOLUTIONS,
Auburn Univ., AL. Dept. of Chemistry.
W. C. Neely.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253377, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report. Auburn Univ., Ala., June 1983. 9 p, 9 Ref. OWRT A-085-ALA(1), 14-34-0001-2101.

Descriptors: *Ozone, *Oxidation process, *Phenols, Water pollution, Organic pollutants, Irradiation, Catalysts, *Wastewater treatment, Pollutant identification.

An investigation was conducted on the catalytically induced decompsotion of ozone in water solution and of the catalysis on ozonization of organic compounds in water solution using soluble metal ions. It appears that the metal ions which can serve as catalysts for ozone decomposition are those having two oxidation states, one above the oxidation potential for water and one below it, so that the catalyst can act as an electron transfer agent for the ozone water hydroxide ion system. The possible utility of catalysis in ozonization may be more limited than usually thought. Since only a restricted group of metal ions can be effective catalysts, it is not realistic to depend on their chance occurance in water; instead, they must be added as required. In addition, the ozone reaction has been shown to be complex; maximum effectiveness of use is not likely until the mechanism is better understood.
W83-03901

PHOSPHATE EXTRACTION USING FLY ASH,
South Dakota State Univ., Brookings. Dept. of Chemistry.
W. P. Jensen, and L. O. Fine.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256701, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Institute Completion Report, South Dakota State Univ., Brookings, March 1980. 8 p, 1 Fig, 4 Tab, 5 Ref. OWRT A-045-SDAK, 14-31-0001-4042.

Descriptors: *Orthophosphates, *Fly ash, *Phosphates, *Phosphorus removal, Wastewater treatment, Water treatment, Hydrogen ion concentration, Temperature, Cooling water, Iron oxides, Aluminum oxides, Minnesota, South Dakota, Organic compounds.

The Big Stone Power Plant located on the Minnesota - South Dakota border is expected to produce 400 tons of fly ash per day during its normal operation. Fly ash has been found to reduce the orthophosphate level in water solutions. No detectable orthophosphate remained in solution using concentrations above 2.5 g of fly ash per liter of solution originally containing 1 ppm phosphate at 30C, and at high temperatures the orthophosphate removal efficiency increased. Using water coming from the cooling towers of a power plant the necessary elevated temperatures could be reached with only a small additional cost. It is the insoluble part of the fly ash that is effective in removing orthophosphate from solution, and it is assumed that the active components in phosphate removal are iron and aluminum oxides. Phosphate removal efficiencies are a sensitive function of pH, with the optimum level around pH 10. It is concluded that fly ash can be used to reduce phosphate levels in surface water systems and as little as 500 ppm fly ash can be used to give near-quantitative orthophosphate removal. (Moore-SRC)
W83-03913

RAW WATER BROMIDE: LEVELS AND RELATIONSHIP TO DISTRIBUTION OF TRIHALOMETHANES IN FINISHED DRINKING WATER,
Tennessee Univ., Knoxville.
R. A. Minear, and C. M. Morrow.
Available from the National Technical Information Service, Springfield, VA 22616 as PB83-256735. Price codes: A13 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center Research Report No. 91, March 1983. 270 p, 70 fig, 46 tab, 75 ref, 4 append. OWRT A-063-Tenn(1), 14-34-0001-1145.

Descriptors: *Bromides, *Trihalomethanes, *Drinking waters, Dichlorobromomethane, Dibromochlorormethane, Bromoform, Chloroform, Ion

chromatography, Gas chromatography, Predictive modeling, Tennessee River, *Tennessee, Pollutant identification.

A study was conducted to examine the effect of raw water bromide on the formation and distribution of trihalomethanes (THMs) in finished drinking water. Twenty major water supplies in East Tennessee were selected for their significant levels of bromine-containing THMs, as demonstrated in previous studies. The cities were sampled quarterly for raw water pH, temperature, NVTOC, and bromide content, as well as finished water pH and NVTOC, and applied chlorine dose, coupled with conjunctive measurement for 7-day THMs. Few data regarding bromide levels in natural waters are currently available since most conventional colorimetric applications lack desired sensitivity, as does direct ion chromatography (IC). Although Fishman's kinetic permanganate method is adequate in the 10-100 ug/l range, it is time-consuming, and prone to certain interferences. An IC method using a sample preconcentration column has been evaluated. The method produced a 1ug/l minimum detection level using deionized water based standards, with 3 percent relative precision at 30 ug/l. Concentrator capacity varied and the highest-capacity concentrator was selected, followed by examination of raw samples regarding ranges and types of other ions present, such that the maximum concentration volume selected (50 ml) resulted in 100 percent retention of bromide. Bromide levels in the raw waters samples were found to range from 10 to 225 ug/l. Concurrent with the field sampling, laboratory chlorination experiments were made using Tennessee River Water, under controlled laboratory conditions of bromide level, chlorine dose, pH, ionic strength, temperature, and organic recursor concentration. Resultant THM formations were monitored over a 96 hour reaction period. The results concurred with observations made in previous work by such researchers as Bird and Rook. Nonlinear regression models for THM formation were generated using the laboratory chlorination data with respect to pH, temperature, chlorine dose, bromide and NVTOC level. Actual values for these variables were substituted into the regression models, using the seasonal field data. Resultant predictive THM values were then compared with actual THM values for those dates sampled. In general, these models were found to give acceptable fits, with an overall index of agreement of 74.1 for one of the models.
W83-03916

WASTEWATER TREATMENT WITH INDUSTRIAL OXYGEN (ABWASSERBEHANDLUNG MIT TECHNISCHEM SAUERSTOFF),
Linde A.G., Hollriegelskreuth (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W83-03927

PRESSURE-RELEASE FLOTATION. PRACTICAL EXPERIENCE FROM SWEDEN (ENTSPANNUNGSFLOTATION. PRAKTISCHE ERFAHRUNGEN AUS SCHWEDEN).
For primary bibliographic entry see Field 5D.
W83-03928

CURRENT STATUS OF WATER DISTRIBUTION IN FRANCE. ORGANIZATIONAL/ADMINISTRATIVE ASPECTS OF THE PROBLEM (SITUATION ACTUELLE DE LA DISTRIBUTION D'EAU EN FRANCE. ORGANISATION-ASPECTS ADMINISTRATIES DU PROBLEME).
In: Techniques et Sciences Municipales, No 3, Supp., p 7-36, March, 1981. 5 Fig, 3 Tab.

Descriptors: *Water supply, *Water distribution, *Water quality control, Water treatment, Water use, Water costs, User charges, Water demand, Water quality standards, Potable water, *France, Reviews, Water resources.

This document presents an overview of the water supply and water distribution situation in France. Discussions off the following topics are included: the water supply situation, water resources, the production and treatment of potable water, the distribution of potable water, the quality of the water distributed, water quality standards and controls, and water prices. The water system serves about 97% of the total population. Demand for water increased by 7% per year between 1969 and 1979. Potable water distribution is the responsibility of local organizations, public or private, which operate within a state-defined framework. Although the quantity of water available far exceeds current needs, the quality of many water sources is unacceptable. About 60% of the public water supplies come from underground sources. Treatment of undergound water is generally both more complex and more expensive than treatment of surface water, and also suffers from the need for small, local treatment facilities. Water distribution installations compromise pumping stations, underground or elevated reservoirs used for pressurizing, a piping system and ancillary equipment, and connections terminating in meters. Water quality regulations in France meet World Health Organization standards and are being adapted to meet directives of the European Economic Community. National regulations stipulate the types and frequencies of analyses which must be conducted. Water prices, which are fixed by local communities, vary widely throughout the country. (Carroll-FRC)
W83-03964

AIR STRIPPING OF VOLATILE ORGANICS FROM DRINKING WATER,
California Univ., Berkeley. School of Public Health.
R. E. Selleck, F. H. Pearson, V. Diyamandoglu, and D. -C. Kim.
UCB/SEEHRL Report No 82-4, Water Resources Center, University of California, Davis, April 1983. 93 p, 25 Fig, 14 Tab, 28 Ref.

Descriptors: *Organic compounds, *Solutes, *Volatility, *Chloroform, *Drinking water, Kinetics, Air-water interfaces, Bubble gages, Groundwater pollution, Ventilation, Mass transfer, Water treatment.

The initial object of this research was to evaluate the kinetics and economics of air stripping of the four trihalomethane (THM) compounds: chloroform, bromodichloromethane, dibromochloromethane, and bromoform. These substances, found in some public water supplies, are carcinogenic. When this research began, adsorption in beds of granular activated carbon was recommended; air stripping was considered economically unviable. The concentrations of the THM compounds established at equilibrium between the air and water phases (Henry's law constants) had to be known before air stripping devices could be evaluated. The emphasis in other Henry's law constant studies has generally been on those organics having volatiles equal to or greater than chloroform--the standard against which other organics are compared. Of the ten halogenated compounds studied, 1, 2 Dibromo-3-chloropropane (DBCP) had the least volatility. It is about 25 times less volatile than chloroform and 10 times more volatile than aqueous ammonia at 20C. For solutes more volatile than chloroform, relatively high stripping factors are favored, thus diminishing adverse effects of low stripping factor (gas phase) resistance to mass transfer, and of axial dispersion. Compounds with volatilities equal to or greater than chloroform can also be removed relatively easily in tray towers without forced air ventilation. An accurate and precise method of determining Henry's law constants for solutes having low volatilities remains to be devised. (Atkins-Omniplan)
W83-03991

REDUCING THE FORMATION OF TRIHALOMETHANES,
IMS Engineers, Fairport, NY.
I. M. Singh, and T. C. McTighe.
Public Works, Vol 113, No 8, p 45-49, August, 1982. 4 Fig, 1 Tab.

Descriptors: *Chlorination, *Trihalomethanes, *Water treatment, Sulfur dioxide, Chlorinated hydrocarbons, Monroe County, *New York.

In-plant studies in trihalomethane (THM) reduction were carried out at the Monroe County Water Authority, Rochester, New York, during the 1978-81. THM were reduced 62% (from an average of 33 to 21 micrograms per liter) by moving the chlorination feed point from the prechlorination mode (prior to flash mixing) to the postchlorination mode (before filtration). This change in feed point did not adversely affect the clarifier effluent water quality nor the finished water quality. Adding chlorine in the postchlorination mode saved $30,000 per year for this plant by reducing requirements for chlorine by 235,000 lbs per year and for sulfur dioxide by 22,000 lbs per year. Sulfur dioxide treatment for residual chlorine control was eliminated except for emergency situations. (Cassar-FRC)
W83-03997

DESTRUCTION OF HAZARDOUS WASTES BY ULTRAVIOLET CATALYZED OXIDATION,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 5D.
W83-04002

INVESTIGATION OF HALOGENATED ORGANICS PRODUCED IN 30 DRINKING WATER SUPPLIES IN SOME ITALIAN DISTRICTS (MODENA, REGGIO EMILIA, AND MANTOVA) (INDAGINE SULLA PRESENZA DI MODENA, REGGIO EMILIA E MANTOVA),
Modena Univ. (Italy). Ist. de Igiene.
R. Olivo, G. Aggazzotti, and G. Predieri.
Igiene Moderna, Vol 76, No 3, p 468-482, September, 1981. 6 Tab, 14 Ref.

Descriptors: *Drinking water, Water pollution, *Organic compounds, *Chloroform, Chemical analysis, *Trihalomethanes, Water supply, Chlorine, Chlorination, Water treatment, Sodium hypochlorite, *Italy.

Data are presented on the presence of some halogenated organics, mainly chloroform and related trihalomethanes, in 30 drinking water supplies of towns in three Italian districts: Modena, Reggio Emilia, and Mantova. In samples drawn from 10 water supplies, no halogenated organics were found, while in 13, some traces appeared. Samples from seven drinking water plants showed higher amounts of halogenated organics (Regio Emilia and Viadana). The total amount of halogenated organics increased after the water was chlorinated with sodium hypochlorite or chlorine gas. (Author's abstract)
W83-04023

INFLUENCE OF UV RADIATION ON THE MICROFLORA OF WATER WITH DIFFERENT DEGREES OF MINERALIZATION (EINFLUSS DER UV-STRAHLUNG AUF DIE MIKROFLORA VERSCHIEDEN MINERALISIERTER WASSER),
Vyzkumny Ustav Balneologicky, Marienbad (Czechoslovakia).
L. Svorcova.
Acta Hydrochimica et Hydrobiologica, Vol 9, No 3, p 303-316, March, 1981. 7 Fig, 5 Tab, 29 Ref. (No English Summary).

Descriptors: *Ultraviolet radiation, *Mineral water, *Disinfection, *Turbidity, *Microorganisms, Mineralization, Spring water, *Czechoslovakia, Bacteria, Enteric bacteria, Coliforms, Pseudomonas, Mesophilic bacteria, Filtration, Radiation, Water quality, *Water treatment, Water pollution treatment, Iron bacteria, Heterotrophic bacteria.

The use of ultraviolet (UV) radiation to disinfect waters from the Czechloslovak spa and spring water industries was investigated. A Stoutz actinator with separate chambers for high-voltage source and discharge tubes was employed to emit UV rays at 253 nm. Mineral waters with evaporation residues of 25-106 and 6,3000-6,500 mg/l and with 101 and 585-630 mg/l carbon dioxide, respectively, were treated. Turbidity levels were up to 50 mg/l Si02, and microorganism density was up to 50,000/ml. The water throughput of the actinator was 2-7 l/min, and the radiation dose was 1.9-8.2 kilowatt-second/sq m. Although results showed that micro-

biological pollution of the raw water varied greatly, the radiation device was able to handle bacteria levels in the millions, so that the standard level for mesophilic bacteria in drinking water of 20 per ml was never exceeded. No coliform microbes or Pseudomonas aeruginosa could be detected in treated water. In general, 99.9% of bacteria were eliminated. A lower performance level was seen in raw water with fewer bacteria. With mild turbidity (up to 15 mg/l Si02), treatment was satisfactory; above this level, water should be filtered before treatment, while water with turbidity > 50 mg/l Si02 cannot be treated in this way. UV radiation was most effective against enterobacteria; 92.8% were killed at a water throughput of 6.5 l/min and 99.9% at 2.5 l/min. Between 88.7 and 97.5% of pseudomonads were eliminated, depending on throughput level. Almost 99.9% of mesophilic bacteria were eliminated at low throughput levels; at higher levels, 86-88% were killed. Under optimal conditions, the total number of heterotrophic bacteria can be reduced five- to sixfold in water with turbidities of < 15 mg/l Si02 and threefold in water with 15-50 mg/l Si02. Iron and manganese bacteria were only slightly affected by UV radiation and quickly reestablished themselves in the water. (Gish-FRC)
W83-04046

CLARIFYING GEOTHERMAL FLUIDS,
Envirotech Corp., Salt Lake City, UT. Eimco Process Machinery Div.
D. A. Dahlstrom, R. W. Moore, Jr., and R. C. Emmett, Jr.
Chemical Engineering Progress, Vol 78, No 10, p 50-55, October, 1982. 4 Fig, 7 Tab, 6 Ref.

Descriptors: *Clarification, *Geothermal resources, *Reinjection wells, Brines, Silica, Wells, Suspended solids, Filters, Geothermal power, Water treatment, *California.

Reinjection of the brines from geothermal wells requires separation of fine suspended solids after desupersaturation of silica. A solids contact clarifier for promoting crystal growth is presented. The clarifier is tied in with a filter, and has been studied during pilot plant operations at the Geothermal Loop Experimental Facility in California near an injection well of Imperial Magma Co. To determine clarification requirements of the spent brine to 10 ppm, a small dual granular media filter was installed. The top bed was anthracite, while the lower bed was sand. This method was able to reduce silica to the saturation point without adding other chemicals. At the same time scaling has been prevented by using the internally recycled solids as seed for crystal growth. By recirculating thickened solids to the pressure flash vessels and crystallizers employed for steam generation, it also appears that scaling can be eliminated in these units. Pressure filtration can be used to produce dewatered solids which can be disposed of in an environmentally acceptable way. Spent brine clarified by granular dual-media filters can be reinjected into the formation at a reasonably constant volumetric rate per unit of pressure drop. There is also the possibility of producing inorganic by-products from the spent brine. Air-brine contact should be prevented for brine reinjection to prevent precipitation of such compounds as ferric hydroxide. Total costs per kWh of electrical production appear reasonable. (Baker-FRC)
W83-04052

CHEMICAL EVOLUTION OF ORGANIC MICROPOLLUTION DURING OZONATION OF FILTERED WATER (EVOLUTION CHIMIQUE DES MATIERES ORGANIQUES AU COURS DE L'OZONATION D'UNE EAU DE SURFACE FILTREE),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
R. Brunet, M. M. Bourbigot, B. Legube, and M. Dore.
Aqua, No 4, p 76-81, April, 1980. 5 Fig, 5 Tab, 13 Ref.

Descriptors: *Ozonation, *Water treatment, *Polarity, *Aromatic compounds, Chromatography, Spectrometry, Organic compounds, Chemical reactions, Laboratory studies, Haloforms, Trihalomethane precursors, Fate of pollutants, Halogenation, *France, Seine River.

Several analytical techniques were used to study the chemical changes occurring in organic micropollution during the ozonation of filtered water from the River Seine. Ultraviolet spectrometry and high-pressure liquid chromatography demonstrated a decrease in the aromaticity and the transformation of nonpolar compounds into substances which are more polar during ozonation. Investigation of the change in haloform precursors confirmed these observations. Ozonation of diluted aqueous solutions of pure products, including such aromatic compounds as phenols, polyhydroxybenzenes, amines, and phenoxyacetic acid derivatives, was used to further evaluate the evolution of organic micropollution. It appears that at an ozonation rate on the order of 2 milligrams per liter the degradation products of the polyhydroxy aromatic precursors are more reactive with chlorine at a neutral pH, while precursors of the methyletone type are more reactive with both iodine and chlorine at a high pH. (Carroll-FRC)
W83-04058

UTILIZATION OF WATER FROM THE OPENCAST MINES SITUATED NORTH OF LEIPZIG (DIE NUTZUNG DES WASSERS AUS DEN TAGEBAUEN NORDLICH LEIPZIGS),
Dresden Forschungszentrum Wassertechnik (German D.R.).
For primary bibliographic entry see Field 3C.
W83-04061

ORGANOHALOGENES AS CARCINOGENS IN DRINKING WATER (ORGANOHALOGENE ALS KARZINOGENE IM TRINKWASSER),
Institute of Hygiene, Gera (German, D.R.).
For primary bibliographic entry see Field 5C.
W83-04064

LOW ENERGY FILTRATION USING BUOYANT MEDIA,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5D.
W83-04149

DECISION MAKING AND RISK MANAGEMENT BY INDIVIDUALS: NITRATE-NITROGEN IN THE CLIFTON SPRINGS, NEW YORK PUBLIC WATER SUPPLY,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Div. of Nutritional Sciences.
For primary bibliographic entry see Field 6F.
W83-04152

FINAL PRETREATMENT FILTERS FOR REVERSE OSMOSIS DESALINATION,
Rohm and Haas Co., Spring House, PA.
For primary bibliographic entry see Field 3A.
W83-04162

DESIGNING AND CONSTRUCTING THE TRAP FALLS WATER TREATMENT PLANT,
Bridgeport Hydraulic Co., CT. Systems Operations Dept.
M. L. Johnson, and P. W. Doe.
Journal of the American Water Works Association, Vol 75, No 3, p 124-131, March, 1983. 2 Tab.

Descriptors: *Filtration, *Dewatering, *Lamella settlers, *Water treatment(Plants), Trap Falls Plant, Bridgeport Hydraulic Company, *Connecticut, Flocculation, Sludge lagoons, Sedimentation.

The Bridgeport Hydraulic Company, Connecticut, built the 25 mgd Trap Falls Reservoir water treatment plant to improve color and turbidity to meet Safe Drinking Water Act provisions. Design and construction problems included a fast schedule, space limitations, and proximity to houses and a highway. To conserve space high filter rates and lamella settlers, which require only 1/12 the space of conventional settling basins, were used. Esthetic considerations included low profile buildings and tanks plus landscaping. Flexibility and provisions for future expansion to 75 mgd were provided. The treatment process included chemical mixing, flocculation, sedimentation, and final filtration. The plant opened in December 1980. In 1981 raw water quality was 18 color units and 1 ntu turbidity units. Treated water averaged 5 color units and 0.42 ntu turbidity. Sludge, stored in lagoons, is dewatered to the consistency of coffee grounds by natural freezing and thawing. (Cassar-FRC)
W83-04175

FORMATION OF ORGANIC CHLORINE IN PUBLIC WATER SUPPLIES,
O'Brien and Gere Engineers, Inc., White Plains, NY.
S. J. Fleischacker, and S. J. Randtke.
Journal of the American Water Works Association, Vol 75, No 3, p 132-138, March, 1983. 6 Fig, 8 Tab, 29 Ref.

Descriptors: *Chlorination, Organic compounds, *Chlorinated hydrocarbons, *Water treatment, Humic acids, Fulvic acids, Water temperature, *Organic chlorine, Disinfection.

The formation of organic chlorine compounds (OC) was studied under different conditions of chlorine dosage, pH, temperature, and ammonia concentration. Precursor material was obtained from groundwater, fulvic acids extracted from groundwater and from peat, commercial humic acid, and municipal secondary effluent. The amount of OC formed increased with increasing chlorine dosage, total organic carbon (TOC) concentration, and temperature, and with decreasing pH. A small dose of chlorine (2 mg per liter) produced more than half as much organic chlorine as a 100 mg per liter dosage. Free chlorine produced much greater amounts of both volatile and nonvolatile chlorine compounds than did combined chlorine. At chlorine doses of 2-100 mg per liter the concentrations (micrograms per liter) of volatile and non-volatile OC formed were: free chlorine, 105-193 and 317-594; combined chlorine, < 1-28 and 40-150, respectively. The proportion of chloroform to total OC increased with higher pH values. Formation of OC was 1/2 to 2/3 complete within the first two hours and essentially complete within 2 days. The level of nonvolatile OC produced over a range of precursor concentration of 0.5-5.0 mg per liter TOC in the presence of free chlorine was 143-1164 micrograms per liter (221-286 micrograms nonvolatiles per mg TOC). Conditions favoring lower OC levels are avoiding prechlorination and excessive chlorine dosages and using combined chlorine, a high pH, and cool water with a low precursor concentration. (Cassar-FRC)
W83-04188

5G. Water Quality Control

SEDIMENT POLLUTION CONTROL IN NORTH CAROLINA,
North Carolina State Univ. at Raleigh.
D. H. Howells, and H. K. Britt.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1228-1247, December, 1982. 2 Fig, 5 Tab, 4 Ref.

Descriptors: *Sediment control, *Revegetation, *Legislation, Water management, *Erosion control, Sediment erosion, Sedimentation, Silting, Highway effects, Vegetation establishment, Water law, Sanitary landfills, Water pollution control, *North Carolina.

A review of state and local sediment control programs in North Carolina in relation to urban and highway construction and sanitary landfill operations is presented. The Sedimentation Pollution Control Act was enacted in 1973 and renewed in 1981 without substantial changes. The mandatory standards of the Act state that where land-disturbing activities are near lakes or natural watercourses, a buffer zone is required to reduce siltation within 25% of the buffer zone nearest the land-disturbing activities. The Act also mandates

that the angle of graded slopes and fills can be no greater than that which can be maintained by vegetative cover or other structures, and when land-disturbing activity is undertaken on a tract of more than 1 acre, the responsible person must retain sediments within the boundaries of the tract during construction and provide a permanent ground cover sufficient to maintain erosion within 30 working days. The Act also covers aspects of technology and training, management, economics, enforcement, education, and public acceptance. State and local programs for sediment control generally enjoy public support. It is recommended that more local programs be set up, that government at all levels should set an example of sediment control practices for private industry, that greater efforts should be made toward enforcing the Sedimentation Pollution Control Act, and that more funds be allocated to meet these goals. (Geiger-FRC)
W83-03860

INTEGRATED CONTROL OF COMBINED SEWER REGULATORS,
Montreal Urban Community (Quebec).
H. N. N. Van, M. Osseyrane, and M. B. McPherson.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1342-1360, December, 1982. 6 Fig, 6 Tab, 9 Ref.

Descriptors: *Water pollution prevention, *Wastewater treatment, Computers, *Process control, *Combined sewer outflows, *Storm sewers, Automation, Data processing, Regulated flow, Prediction, Water management, Flow rates, Pollution load, Interceptor sewers.

The feasibility of integrating all combined sewer system regulators on a given interceptor by means of a centralized automatic control scheme when no in-line or other storage system can be called upon was examined in simulation studies for 10 dynamic combined sewer regulators on a Montreal interceptor over one season. Unless flowrates can be predicted adequately in advance, no advantage over local automatic dynamic regulator control can be obtained by integrating the operation of regulators on a given interceptor. In addition, the diversion of flows by the regulators in the form of overflows must be programmed so as to minimize overflows at some time period over the duration of storm events. When a pollutant characteristic that diminishes in concentration over time is considered, it is possible to reduce emissions at designated outfalls by using integrated regulator operation when a weighting function and flowrate prediction are employed. The CUM, a special metropolitan district of Montreal, is seeking to completely automate its interceptor system. A computer based management information and control system was adopted by CUM to deal with greater amounts of information and achieve greater regulation. (Geiger-FRC)
W83-03862

USING EPA'S COMPUTERIZED DATA BASE (STORET) TO ANALYZE FOR AGRICULTURAL WATER POLLUTION,
Virginia State Water Control Board, Richmond. Bureau of Water Control Management.
For primary bibliographic entry see Field 5B.
W83-03895

MOVEMENT OF WATER AND NITRATE-NITROGEN IN A TYPICAL SILT LOAM SOIL OF WESTERN KANSAS,
Kansas Water Resources Research Inst., Manhattan.
L. R. Stone.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255497, Price codes: A03 in paper copy, A01 in microfiche. Contribution No 238, September 1982. 24 p, 11 Tab, 8 Ref. OWRT A-101-KAN(1), 14-34-0001-0118.

Descriptors: *Corn, Water use, *Water use efficiency, Profile soil water depletion, Grain yield, *Nitrate-nitrogen movement, *Kansas, Loam, Irrigation.

During a 2-year study at Tribine, Kansas, we evaluated the movement of water and nitrate-nitrogen in a deep, silt loam soil derived from loess. Treatment was irrigation amount (76, 114, or 152 mm of water per irrigation) and the test crop was corn (Zea mays L.). All plots recieved a pre-plant irrigation of approximately 150 mm in April of each year. In-season irrigation water was applied to basin plots by using gated pipe. In November 1980 and in December 1981, 180 kg of nitrogen per hectare were applied to the plot area. Nitrate-nitrogen concentration in the soil profile was not significantly influenced by irrigation amount. Water use efficiency was significantly greater with the 114 and 152 mm irrigation amounts than with the 76 mm amount. The 76 mm irrigations did not wet the soil to the 60 cm depth in 1981. For our study conditions, the larger irrigation amounts (114 and 152 mm) did not cause leaching of nitrate-nitrogen from the corn root zone. Undoubtedly, excessive amounts of nitrogen fertilizers and excessive amounts of irrigation water could produce nitrate-nitrogen leaching from these soils. But recommended rates of nitrogen fertilizers and judicious use of irrigation water will not cause extensive in-season leaching of nitrate-nitrogen in the deep, silt loam soils of western Kansas.
W83-03908

COPPER SUSCEPTIBILITY OF THREE GROWTH STAGES OF THE GREEN ALGA HAEMATOCOCCUS,
Iowa State Univ., Ames. Dept. of Botany.
N. L. Pearlmutter, and M. A. Buchheim.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256768, Price codes: A05 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Completion Report No 129, July 1983. 76 p, 38 Fig, 8 Tab, 90 Ref. OWRT A-081-1A(1), 14-34-0001-2117.

Descriptors: *Copper sulfate, *Haematococcus, *Algal growth stages, Algal blooms, *Chlorophyta, *Eutrophication, Water pollution effects.

Three growth stages of the green alga, Haematococcus, were examined to determine their survival and recovery following a 12-hour exposure to copper. Copper uptake of flagellate cells, palmelloid cells, and akinetes was measured by atomic absorption spectrophotometry, and cell counts were used to determine the numbers of surviving cells as well as growth rates following exposure to copper. The location of amassed copper was determined with cytochemical methods developed for light microscopy and transmission electron microscopy. Flagellate cells accumulated less copper per cell than palmelloid cells or akinetes. When compared to the other growth stages on a volume basis, however, flagellate cells were found to have accumulated significantly more copper. This may account for the greater sensitivity of flagellate cells to low concentrations of copper. High metabolic activity of flagellate cells to low concentrations of copper. High metabolic activity and a large surface-to-volume ratio are also implicated as major factors contributing to decreased survival and slow recovery of flagellate cells from copper poisoning. Akinetes were least affected by exposure to copper although germination of palmelloid-producing akinetes was inhibited. A copper-enriched but incomplete growth medium was used for incubation of the cells during treatments. The survival and growth of cells incubated in this medium and a complete growth medium was compared and the differences found to be negligible. Copper accumulated in the cell walls and external cell mucilage of inhibited akinetes and palmelloid cells. With the exceptiion of a few cytoplasmic sites, deposition of copper was complete throughout dead cells of any growth stage. Starch bodies, vacuoles, and occasionally pyrenoids did not accumulate detectable amounts of copper. Cellular sites external to the plasma membrane appear to act as nontoxic areas that may sequester copper ions and prevent them from reaching more sensitive cytoplasmic sites.
W83-03919

DYNAMIC ESTIMATES OF RIVER POLLUTION UNDER CONDITIONS OF REGULATION OF THE RIVER AND ANTHROPOGENIC RUNOFF,
For primary bibliographic entry see Field 5B.
W83-03937

MECHANICAL CLEANING EQUIPMENT FOR STORMWATER BASINS (MASCHINELLE RAUMEINRICHTUNGEN FUR REGENBECKEN),
Rheiner Machinenfabrik Windhoff A.G. (Germany, F.R.).
For primary bibliographic entry see Field 8C.
W83-03942

LEGAL LIMITS FOR 'EXCESSIVE' THRESHHOLD LEVELS FOR COMPANIES INDIRECTLY DISCHARGING WASTEWATER (RECHTLICHE GRENZEN FUR GRENZWERTE BEI INDIREKTEINLEITERN),
For primary bibliographic entry see Field 6E.
W83-03943

PRINCIPALS OF ECOLOGICAL AND HYGIENIC REGULATION OF WATER QUALITY,
For primary bibliographic entry see Field 6E.
W83-03950

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: IV. NITROGEN,
Department of Agriculture, Summerland (British Columbia). Research Station.
For primary bibliographic entry see Field 5B.
W83-03988

ENHANCEMENT OF WATER QUALITY IN NEBRASKA FARM PONDS BY CONTROL OF EUTROPHICATION THROUGH BIOMANIPULATION,
Nebraska Univ., Lincoln.
G. L. Hergenrader.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265033, Price codes: A03 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, September 1983. 30 p, 9 Tab, 5 Ref. OWRT A-067-NEB(1), 14-34-0001-2129.

Descriptors: *Water quality control, Zooplankton, Phytoplankton, Biomass, Water purification, Predation, *Nebraska, Eutroplication, *Biomanipulation, Piscivore, Planktivore, *Farm ponds.

This research was a pilot project to demonstrate the feasibility of improving water quality in surface waters by enhancing natural zooplankton grazing on phytoplankton through manipulation of the fish communities. Young-of-year planktivorous crappie and piscivorous northern pike were introduced into two eutrophic farm ponds in the Lower Platte South Natural Resources District to evaluate the effects of controlled planktivore predation on zooplankton and phytoplankton communities. For each experimental treatment (i.e., presence of planktivore alone; presence of piscivore with planktivore) one pond was used as a natural 'control' to compare against the pond receiving the experimental treatment. In the ponds containing planktivorous young-of-the-year crappie, the zooplankton community underwent a shift in size and composition towards a smaller species assemblage, less efficient as grazers. Phytoplankton biomass increased dramatically during this period with a resultant decrease in water clarity. In the experimental pond receiving piscivorous pike, the planktivore population was greatly reduced in numbers. As a result, the zooplankton community shifted back towards an assemblage of moderate to large sized species more efficient as grazers. However, phytoplankton biomass remained fairly constant during the growing season at levels approximately 30% lower than the previous years maximum. The overall trends observed over the 2-year study period supported the hypotheses that piscivore predation upon planktivores could release zooplankton grazers from size selective predation pressure and in turn graze down the phytoplankton biomass to lower levels.
W83-03995

CLOSTRIDIUM PERFRINGENS AS AN INDICATOR OF STREAM WATER QUALITY,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5A.
W83-03999

ENVIRONMENTAL CORRECTIVE PROGRAMS AT THE LA GRANDE COMPLEX (LES AMENAGEMENTS CORRECTIFS D'ENVIRONNEMENT AU COMPLEXE LA GRANDE),
Societe d'Energie de la Baie James, Montreal (Quebec).
For primary bibliographic entry see Field 6G.
W83-04060

GROUNDWATER POLLUTION: A THREAT TO PUBLIC WATER SUPPLY. (GRUNDWASSERVERUNREINIGUNGEN - BEDROHUNG FUR DIE OFFENTLICHE WASSERVERSORGUNG.),
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
H. Sontheimer, P. Cornel, J. Fettig, and U. Rohmann.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 11, p 521-530, 1982. 9 Fig, 5 Tab, 30 Ref.

Descriptors: *Groundwater pollution, *Water treatment, Drinking water, Groundwater management, Water quality, Hydrocarbons, Nitrates, Physicochemical treatment, Biological treatment.

Halogenated hydrocarbons and nitrate have been increasingly found as groundwater pollutants in the past few years. Frequently the source of the contaminants is well known. However, if the water is to be restored to a quality suitable for drinking, specific treatment measures must be undertaken. Physicochemical methods such as stripping and adsorption can be used for the removal of halogenated hydrocarbons. Until recently these procedures had not been much used for the treatment of groundwater; they are well known methods, but are not necessarily inexpensive. Biological processes seem to have the edge for removal of nitrate contaminants, especially if part of this treatment will be done using underground passage, as this method has proven worthwhile in the treatment to remove oil polluted waters in the Karlsruhe waterworks. (Baker-FRC)
W83-04090

EPA'S NEW LAND DISPOSAL RULES-A CLOSER LOOK,
For primary bibliographic entry see Field 5E.
W83-04100

THE REGIONAL SEAS PROGRAM: WHAT FATE FOR UNEP'S CROWN JEWELS.,
For primary bibliographic entry see Field 5B.
W83-04131

ROLE OF CONSERVATION EASEMENTS IN INLAND LAKE MANAGEMENT,
Wisconsin Univ.-Madison. Water Resources Center.
For primary bibliographic entry see Field 6E.
W83-04153

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

ECONOMIC OPTIMIZATION OF IRRIGATION,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 3F.
W83-04007

OPTIMUM CAPACITY OF A RUN-OF-RIVER PLANT,
International Engineering Co., Inc., San Francisco, CA.
For primary bibliographic entry see Field 8C.
W83-04167

6B. Evaluation Process

LANDOWNERS, RECREATIONISTS, AND GOVERNMENT: COOPERATION AND CONFLICT IN RED RIVER GORGE,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 7A.
W83-03903

REUSE VERSUS RETURN FLOWS: CONSIDERATIONS FOR SELECTING A WATER SUPPLY STRATEGY,
Nevada Univ. System, Reno. Desert Research Inst.
M. D. Mifflin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265082, Price codes: A02 in paper copy, A01 in microfiche. Publication 883, August 1983. 13 p, 5 Fig, 1 Tab, 5 Ref. OWRT A-079-NEV(1), 14-34-0001-7059.

Descriptors: *Water management, *Water reuse, Water requirements, Water supply development, *Return flow, *Nevada, Las Vegas.

This study addresses potential water management strategy to serve the Las Vegas area from the present time on into the 21st century. The U.S. Supreme Court Decree in Arizona vs. California defined Colorado River allotments to the Decree States in terms of annual consumptive use. In other words, water diverted from the River that is not consumptively used is allowed to flow back to the Colorado River for return flow credit. The net diversion is considered to be the legal limit but gross yearly diversions can considerably exceed this value if return flow credits are high. Water reuse becomes viable if costs associated with return flow credit water become high. Then the economic advantage of allowing wastewater to return to the Colorado River become lost. Return flow water quality requirements and associated treatment costs for wastewater flowing in the Wash, as well as the incremental and treatment costs for using the additional Lake Mead water in an amount equal to the return flow credit are the major costs associated with the return flow management option. However, as long as the cost of using Lake Mead water is lower than the costs associated with reusing the wastewater, the management strategy developed in the 1960's remains viable. Over the next 50 years, the reuse strategy could be adopted in lieu of the return flow credit strategy since sufficient water is available to meet all anticipated needs. The potable water available from the Colorado River without return flow credit to Las Vegas Valley is 280,000 acre-feet/yr which exceeds the projected year 2030 potable requirement of 220,000 acre-feet. Use of that quantity of potable water should generate approximately 120,000 acre-feet of wastewater which could be reclaimed and reused. Thus, the combined available Colorado River water, reclaimed and reused wastewater plus groundwater exceed the year 2030 total water demand.
W83-04001

QUICK RETURNS DON'T PAY IN WATER AND SOIL CONSERVATION,
A. Bell.
Soil and Water, Vol 16, No 5-6, October, 1980. 2 Tab.

Descriptors: Planning, Water resources development, *Economic aspects, Irrigation projects, Water supply, Water demand, *New Zealand, Regulations, *Costs.

On 18 December 1979, the New Zealand Cabinet Committee on Expenditure directed that all new water and soil schemes commencing after March 1980 would have to show an internal rate of return of at least 15%. Before this directive the internal rate of return (IRR) had been only one of eight criteria applied for funding water and soil works. Other criteria included the need to protect assets and the spread of works by types and regions. Demanding an exclusive and immediate economic criterion for schemes would eliminate most erosion and flood control works, many rural water supply schemes, and pastoral irrigation schemes. Only irrigation for horticulture was relatively certain to get funding. Virtually no works would go ahead in the South Island. The solution to the resulting confusion was to form a committee, and on 9 April a joint Cabinet/Caucus committee was established. On August 4, 1980, the Committee on Expenditure approved a final review of criteria and subsidy rates which should remain valid for the foreseeable future. The new policy restores order to water and soil funding from 1 October 1980. (Baker-FRC)
W83-04024

P.I.D. REGULATION REVISITED,
Lavalin, Inc., Montreal (Quebec).
G. D. Ransford.
International Water Power and Dam Construction, Vol 35, No 1, p 31-34, January, 1983. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Safety, *Hydroelectric plants, *Resources management, *Economic aspects, *Dam stability, Dams, Frequency analysis, Mathematical studies, Surge tanks, Electrical equipment, Evaluation.

A previous analysis compared two-element (proportional-integral) governors and three-element (proportional-integral-differential) governors for the safety regulation of hydroplants and concluded that a three-element governor eliminated the need for surge tanks, discharge regulators, larger pipelines or higher values of the generator flywheel effect. The implications of added derivative control were examined further using optimization on an objective basis. Considerations of frequency control, waterhammer transients, and rotor acceleration were also taken into account. Results showed that the slightly more precise three-element governor's control over frequency variations seems to be offset by a sharp deterioration in waterhammer. Conventional servomechanism analysis using transfer functions is invalid when using a proportional-integral-differential governor. It was concluded that there is no reason to prefer a three-element governor over a two-element governor or accelerotachometric type. (Geiger-FRC)
W83-04080

AN ECONOMIC EVALUATION OF BENEFITS AND COSTS OF MAINTAINING INSTREAM FLOWS,
Utah Water Research Lab., Logan.
R. Narayanan, D. T. Larson, A. B. Bishop, and P. Amirfathi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105543, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-83/04, Utah Water Research Lab., June 1983. 48 p, 9 Fig, 35 Tab, 34 Ref. OWRT A-052-UTAH(1), 14-34-0001-1147.

Descriptors: *Instream flow, Recreation, *Benefits, *Cost-benefit analysis, Opportunity costs, Recreation, Irrigation, Water rights, Water law, Appropriation, Market value, Resource allocation, Fishing, Low flow, *Utah, Little Bear River.

Instream flows enhance recreation, hydropower, fish and wildlife maintenance, and riverine ecosystems. Each use has water requirements that vary over time in unique patterns. The largest determines the overall instream requirement at any given time and must be considered in competition with the demand for municipal and agricultural uses. Two obstacles to integrating instream uses into the appropriation system of water law are difficulty in satisfying the legal requirements of an appropriation for a public use and the fact that instream flow uses are more environmental than economic in character. The extreme options for allocating flow between these user groups are to give them the most junior rights under appropriative water law and provide instream flows to a desired average, and to give instream flows top priority. Neither extreme is reasonable; the first

sometimes allocates no water at all for instream flow in dry years and the second inflicts unnecessarily large benefits foregone on agriculture. A compromise is to reserve some instream flow with senior rights. A stochastic linear programming model was used to estimate the expected benefits foregone to agriculture users. The models provided a framework for maximizing benefits and were applied to various flow levels. A case study application to the Blacksmith Fork of the Little Bear River was based on the instream values being predominantly recreational with benefit estimates based on user surveys and travel costs. Agricultural losses increased as more senior rights were taken, but the method for providing instream flows made less difference for larger targeted flows. The results provide a basis for optimizing instream flow levels, but further methodological development is needed.
W83-04156

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

THE PROBLEMS AND BENEFITS OF SMALL-SCALE HYDRO (PART 2).
International Water Power and Dam Construction, Vol 35, No 3, p 49-54, 1983. 3 Fig, 2 Tab.

Descriptors: *Automation, *Economic aspects, *Conferences, *Hydroelectric plants, *Developing countries, *Cost-benefit analysis, Project planning, Evaluation, Construction costs, Operating costs, Rural areas.

The advantages and techniques of remote and automatic operation of hydro units were the major themes of Session II of the First European Conference on small hydro systems. Papers were presented on programmable control, equipment choice, hard-wired systems, and the differing requirements of isolated and integrated small-scale hydro stations in Italy, Germany, and France. The third session of the conference examined financial, economic and administrative aspects of small hydro schemes. Papers given at this session discussed the activities of the UNIDO organization in the field of small hydro, small recuperation plants, small scale hydro schemes for developing countries, and cost feasibility for the construction of a new hydro unit. Other speakers discussed the factors affecting the development of micro hydro schemes in Switzerland, the administration of hydro streams in France, the application of small hydro for rural electrification in developing countries, and the development of small hydro in Italy. The potential markets for small hydro in the United States were also examined. (Geiger-FRC)
W83-04170

6D. Water Demand

DROUGHT MANAGEMENT CONCEPTS: LESSONS OF THE 1976-77 U. S. DROUGHT,
R. Narayanan, T. C. Hughes, M. McKee, H. Fakhraei, and H. H. Fullerton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-257527, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-83/02, June 1983. 87 p, 13 Fig, 23 Tab, 78 Ref, 1 Append. OWRT B-024-UTAH(1), 14-34-0001-1271.

Descriptors: *Water demand, Water supply, Municipal water, *Drought, Pricing regulations, *Water conservation, Water use, User charges, *Utah, Model studies.

The 1976-77 drought inspired a variety of efforts to ration the limited water supply. The three most common in Utah were found from a survey of 33 municipal water supply systems to be 1) restrictions on times when outside use is permitted, 2) price increases, and 3) upper limits to allowable monthly water use. A regression model applied to use data for these communities showed that mandatory water use regulations proved much more effective than price increases in reducing water use. A theoretical analysis of the demand and supply functions showed the current pricing schedule to be about optimal. A third model showed that there were substantial economic losses, largely in the form of reduced consumer surplus for residential users, associated with the 1977 regulations. The third model analyzed various management policies in terms of their impact on net benefits to the agricultural and municipal sectors. The model revises water allocations monthly, to match a changing hydrologic situation. It can very constraints in a manner that simulates an institutional environment ranging from total freedom of price changes and water exchanges between sectors to those constraints existing during the 76-77 drought.
W83-03922

REUSE VERSUS RETURN FLOWS: CONSIDERATIONS FOR SELECTING A WATER SUPPLY STRATEGY,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 6B.
W83-04001

6E. Water Law and Institutions

FEDERAL TAX LAWS AND SOIL AND WATER CONSERVATION,
California Univ., Davis. Dept. of Agricultural Economics.
R. A. Collins.
Journal of Soil and Water Conservation, Vol 37, No 6, p 319-322, November/December, 1982. 1 Ref.

Descriptors: *Taxes, *Farming, Conservation, Tax rates, *Soil conservation, *Water conservation, Legal aspects, Agriculture, *Tax laws.

Federal tax laws relating to soil and water conservation have become increasingly complex since 1954. The 1954 Internal Revenue Code permits deduction (limited to 25% of gross farm income) of soil conservation expenditures to reduce ordinary taxable income rather than capital gains income. For an average farmer this provision reduces the farmer's cost of a conservation project by about 17% for small projects and by a smaller percentage for larger projects. The 25% deduction limit is more beneficial to farmers in the lower tax brackets. It may be carried backward or forward, avoiding tax losses associated with net operating losses. The 1969 Reform Act eliminated some of the tax shelters used by high income professionals, qualified as farmers by law, but more interested in land development for profit. This law required investors to retain land for 10 years to take advantage of the capital gains provision. The 1978 Revenue Act and its interpretations are complex and easily misunderstood. The Act concerns taxation of the government's contribution to conservation projects. Farmers who do not plan to sell their land in the next 20 years can realize a tax advantage. (Cassar-FRC)
W83-03857

SEDIMENT POLLUTION CONTROL IN NORTH CAROLINA,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 5G.
W83-03860

INSTITUTIONAL FRAMEWORK FOR RURAL WATER SUPPLY: A COMPARATIVE ANALYSIS OF NORTH CAROLINE, SOUTH CAROLINA, AND VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. E. Cox, and K. S. Patrizi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255430, Price codes: A09 in paper copy, A01 in microfiche. Virginia Water Resources Center Completion Report, Blacksburg, January 1983. 186 p, 19 Tab, 5 Append, 352 Footnotes. OWRT B-095-VA(1).

Descriptors: *Institutional constraints, *Water supply, Administrative regulation, Drinking water, *Rural areas, Water supply development, Water quality, Planning, Governmental interrelations, Financing, *Virginia, *North Carolina, *South Carolina.

Americans living in rural areas and small communitites experience a disproportionate share of water supply problems--both of quantity and quality. Their systems confront special economic and financial problems because of the higher costs of system development in areas of low population density and the generally lower incomes of residents. This study sought to determine whether existing institutions adequately recognize and address the unique problems experienced by water supply systems in rural areas--specifically, in North Carolina, South Carolina, and Virginia. The report first describes a variety of institutional arrangements for provision of water supply and their strengths and weaknesses. Second, it analyzes programs for technical and financial assistance from federal and state governments and includes a comparative evaluation of the programs of the three states. Third, it analyzes federal and state regulatory mechanisms applicable to water supply operations, with special emphasis on the impact of such regulation on small systems. The analysis of the laws and administrative programs of three states is extended by case studies to illustrate actual operational experiences of rural suppliers within these states.
W83-03902

LEGAL LIMITS FOR 'EXCESSIVE' THRESHHOLD LEVELS FOR COMPANIES INDIRECTLY DISCHARGING WASTEWATER (RECHTLICHE GRENZEN FUR GRENZWERTE BEI INDIREKTEINLEITERN),
H. Keune.
Wasser, Luft and Betrieb, Vol 25, No 7/8, p 16-17, July/August, 1981. 24 Ref. (No English Summary).

Descriptors: *Water law, *Heavy metals, *Water quality standards, *Financing, *Wastewater management, Wastewater treatment, Municipal wastewater, Industrial wastewater, Wastewater disposal, Sludge disposal, Legal aspects, Agriculture, *Federal Republic of Germany, Costs, Economic aspects.

The designing of a West German ordinance concerning the application of treated sludge of agricultural land has led to threshold levels for heavy metals and other substances in wastewater being proposed by municipal wastewater authorities that are impossible to adhere to. It is considered likely that state authorities will follow this trend. The argument for setting such high standards is that ecology is more important than economy; in this case, it is the public economy that is being set against the private (i.e., businesses that are expected to conform to the standards at their own cost), and the result will be loss of jobs or even the closing of businesses. This trend can only be altered by a disclaimer being written into the law for moderately sized companies who discharge heavy metals or by the municipalities' assumption of the financial responsibility for wastewater treatment. If the trend is not reversed, the danger exists that environmental protection will strangle itself by being financially unrealizable. In civil law, regulations that lead to preventing a business from operating or to prevention or impedance of its economic growth are disallowed; this could also apply to the banning of equipment that is not environmentally compatible. A well-know principle of law states that nonsensical regulations or those that legislate something realistically impossible are invalid. There is also the concept of the 'excess ban' that calls into question administrative acts that require actions considered excessive. The applicability of these principles should be investigated. The principle of industry-wide standards may also be applied: existing regulations applicable to an entire industry can only be changed with good reason, and proposals by individual municipalities are not reason enough. State law has already placed the responsibility for wastewater treatment on the municipalities, though they also have the authority to order preliminary treatment by private industry (while confirming to the above principles). (Gish-FRC)
W83-03943

PRINCIPALS OF ECOLOGICAL AND HYGIENIC REGULATION OF WATER QUALITY,
G. N. Krasovskii, L. I. El'piner, A. M. Beim, and I. V. Sutovskaya.
Water Resources (English Translation), Vol 9, No 2, p 111-112, March-April, 1982. 2 Tab, 59 Ref. Translated from Vodnye Resursy, No 2, p 3-19, March-April, 1982.

Descriptors: *Water quality, *Regulations, Water conservation, Fisheries, Public health, Water quality control.

The extremely complex problems of the conservation of nature have a number of important aspects occuring in connection with the provision of safe water use and protection of waters from pollution. Currently the approach to this problem is associated with the need to solve problems of preserving freshwater bodies as components not only of the hydrosphere but also of the biosphere of the entire planet. Analysis of current scientific literature indicates a need to change from the solution of problems of individual water users to an examination of problems of mankind as a whole when it is a matter of quality of water resources. Development of the maximum allowable concentrations of pollutants was based on current hygienic standardization of harmful substances. Hygienic standards regulate the content of pollutants only in those water bodies which are used for domestic water supply and amenities, including recreational water use, and not over the entire length of the water body or at places of the outfall of wastewaters but only at the first points of public water use from the source of pollution. The occurrence of new pollution sources and the expansion of their geography led to the occurrence of a number of new and important aspects in the problem of protecting water bodies. The differences in purposes of water use and in the water quality requirements of different water consumers gives rise to the simultaneous coexistence of hygienic and fishery standards for the same chemical water pollutants. Technical and economic approaches to water quality regulation are considered along with approaches to ecological standardization and principles of unified ecological and hygienic standardization. (Baker-FRC)
W83-03950

GROUNDWATER PROTECTION - SUFFICIENT AGAINST THREATS TO PUBLIC WATER SUPPLY DUE TO GROUNDWATER POLLUTION. (GRUNDWASSER-SCHUTZ - AUSTREICHEND ANGESICHTS DER BEDROHUNG DER OFFENTLICHEN WASSERVERSORGUNG DURCH GRUNDWASSERVERUNREINIGUNGEN.),
Bonn Univ. (Germany, F.R.). Inst. fuer das Recht der Wasserwirtschaft.
For primary bibliographic entry see Field 5B.
W83-04093

ROLE OF CONSERVATION EASEMENTS IN INLAND LAKE MANAGEMENT,
Wisconsin Univ.-Madison. Water Resources Center.
W. P. O'Connor, and G. Chesters.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105519, Price codes: A02 in paper copy, A01 in microfiche. Publication No WIS WRC 83-03, 1983. 24 p, 1 Tab, 26 Ref. OWRT A-096-WIS(1), 14-34-0001-0153.

Descriptors: *Conservation, *Easements, *Inland waterways, *Lakes, *Taxes, Economic aspects, Legal aspects, Preservation, Water quality, Lake management.

The discussion is designed to provide lake management organizations with information on the nature of conservation easements and some of the legal, institutional and tax (income, estate, and property) considerations involved in developing conservation easement programs. Certain aspects of conservation easements are discussed using representative jurisdictions as examples; however, the survey is not intended to be exhaustive. Instead, it serves as an introduction to a complex subject area, providing the reader with an understanding of the issues involved and the kinds of lake management objectives that conservation easements may help attain. Most states have enacted statutes--including the recently adopted Uniform Conservation Easement Act--recognizing conservation easements and ensuring their long-term enforceability. The donation of these partial interests in real property by conservation organizations is encouraged by specific provisions of the Internal Revenue Code permitting landowners to deduct from taxable income the value of qualifying easements granted to public or certain private organizations. Additional tax incentives for donation are available to land-owners under federal estate tax law and the death, inheritance, income, and real property tax laws of many states. This device offers potential in lake management for the enhancement and protection of water quality and for preservation of undeveloped or scenic areas, thereby benefitting the recreational and aesthetic aspects of the lake and its watershed.
W83-04153

AN ECONOMIC EVALUATION OF BENEFITS AND COSTS OF MAINTAINING INSTREAM FLOWS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 6B.
W83-04156

6F. Nonstructural Alternatives

A COMPLEX SYSTEM FOR THE STADARDIZATION OF WATER POLLUTANTS -- DISCUSSION OF PROPOSALS MADE BY KRASSOVSKIY ET AL (KOMPLEXES SCHEMA ZUR NORMIERUNG VON WASSER SCHADSTOFFEN -- EINE BETRACHTUNG ZU VORSCHLAGEN VON KRASSOVSKIJ ET AL),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
H. -J. Dobberkau, H. Horing, and K. Strobel.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 401-406, May, 1980. 1 Tab, 4 Ref. (No English Summary).

Descriptors: *Water pollution sources, *Standards, *Classification, *Public health, *Water quality control, Water pollution control, Water quality standards, Systematics, Toxicity, Toxins, Self-purification, Organoleptic properties, Hazardous materials, Pollutants.

The rapidly increasing development, application, and distribution of synthetic chemical compounds has necessitated the establishment of standards for potential environmental pollutants. A complex system for the testing and setting of standards for harmful substances in water proposed by Krassovsky et al. in 1978 is described and discussed. The basis of the program is determination of the MAC for each substance, i.e., the maximal allowable concentration in water that has no direct or indirect influence on the health status of present and future generations. The establishment of standards rests on testing of the substance in question according to three characteristics of harm: influence on the hygienic regime of the water (self-purification capacity), influence on organoleptic properties, and influence on the health status of the population. For the first two characteristics, standardized experiments are conducted, including double-blind-type studies for odor and taste. Animal experiments are performed for the third characteristic. Additional principles of the system are that a complex investigation to establish each substance's limiting characteristic of harm must be made, that a threshold of influence can be determined for each characteristic of harm, that the maximum no-effect concentration (MNC) can be found, and that the MAC must be retested periodically. Hazard category is established by a stepwise procedure, in which toxicological studies are stopped once the hazard fulfills the requirements for a certain class -- in this way the length of study is kept short. (Gish-FRC)
W83-04065

DECISION MAKING AND RISK MANAGEMENT BY INDIVIDUALS: NITRATE-NITROGEN IN THE CLIFTON SPRINGS, NEW YORK PUBLIC WATER SUPPLY,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Div. of Nutritional Sciences.
C. A. Bisogni, and A. T. Lemley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105501, Price codes: A02 in paper copy, A01 in microfiche. Center for Environmental Research Completion Report, October 1983. 8 p, 2 Ref. OWRT A-098-NY(1), 14-34-0001-2134.

Descriptors: Water supply, *Nitrate, *Public participation, Notification, Customer concerns, Social aspects, *New York, Clifton Springs, *Nitrogen, *Attitudes, Domestic water, *Risks, *Decision making, Surveys.

The public water supply in Clifton Springs, New York has nitrate levels greater than the maximum contaminant level of 10 mg N/liter. The customers have been notified since 1978 by mail, and a Citizens' Advisory Committee was established in 1981 in order to secure public cooperation in solving the problem. A survey project which included a mail questionnaire and indepth interviews in 10% of the village households was instituted to determine the effectiveness of both notification and resident involvement in influencing the public knowledge of their water problem, their concerns about water quality, and their willingness to pay to correct the problem. Respondents had a good understanding of the specific water problem and a positive attitude toward the newsletter published by the Citizens' Advisory Committee. The results indicate that public participation in decision making is an effective method of educating the community and of securing its cooperation. Recommendations for public education programs on water contamination problems are made.
W83-04152

6G. Ecologic Impact Of Water Development

DEFINING STREAM FISH MICROHABITAT REQUIREMENTS FOR WATER PROJECT PLANNING,
Utah State Univ., Logan. Coll. of Natural Resources.
W. T. Helm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256727, Price codes: A02 in paper copy, A01 in microfiche. Utah Center for Resources Research Completion Report, Utah State University, Logan, November 1982. 13 p, 1 Fig, 3 Tab, 21 Ref. OWRT B-177-UTAH(1), 14-34-0001-9140.

Descriptors: Brown trout, *Fish management, *Aquatic habitats, Light penetration, *Environmental impact, Stream fisheries, *Utah, Logan River, *Project planning.

Environmental concerns are generating criteria for protecting stream fish habitat from flow regime changes caused by water resources development and use, but the lack of scientific basis for many of the promulgated water requirements creates grave doubts that true protection will be achieved. Economically productive water use is being prevented without assurance of environmental gain. The need for scientific habitat need characterization was addressed through the systematic collection of data on brown trout preferences in the Blacksmith Fork of the Logan River, Utah. Brown trout daily activities were divided between resting and feeding, and the fish population was divided among age groups observed to have different times and locations for these activities. Microhabitat components (velocity, depth, and light) were defined, measured, and mapped for a 90-meter river section. A scuba diver searched the area identifying located brown trout by age group and activity. Comparisons of habitat character with fish locations set a range of acceptable numerical values for each component. For example, adult trout require velocities less than 24 cm/sec for resting and less than 45 cm/sec while feeding. These quantified component ranges can be used for formulating habitat protection ranges that

will effectively protect fish while permitting economical but harmless water development.
W83-03915

THE NON-FISHERIES BIOLOGICAL RESOURCES OF THE HANFORD REACH OF THE COLUMBIA RIVER,
Battelle Pacific Northwest Labs., Richland, WA.
W. H. Rickard, W. C. Hanson, and R. E. Fitzner.
Northwest Science, Vol 56, No 1, p 62-76, 1982. 5 Fig, 2 Tab, 34 Ref.

Descriptors: *Wildlife, *Environmental effects, *Recreation, Reservoir operation, Nuclear powerplants, Powerplants, Hanford, *Columbia River, *Washington, Radioisotopes.

The non-fisheries biological resources of the 90 km long Hanford Reach of the Columbia River are documented. This free-flowing and undammed section of the river has been a wildlife refuge for 35 years. Streamside vegetation, consisting of a narrow zone of shrub-willows, rushes, grasses, and forbs, has responded to the dramatic changes in water levels produced by reservoir operation upstream. However, no baseline reference points are available for comparison. Bald eagles, attracted to salmon carcasses, have increased during the past 20 years from 6 to 20. Many species of geese, ducks, fish-eating birds, upland game birds, and shore birds have been listed. Numbers of geese and ducks have been decreased by predation and by disturbance from boating and hunting. Mule deer are numerous, but the population is not robust. Coyotes are numerous, preying on nesting geese and mule deer fawns. A variety of furbearing mammals and small mammals have also been observed. Several researchers have investigated the levels of radionuclides and persistent chemicals in animal bodies and droppings. (Cassar-FRC)
W83-04017

ENVIRONMENTAL CORRECTIVE PROGRAMS AT THE LA GRANDE COMPLEX (LES AMENAGEMENTS CORRECTIFS D'ENVIRONNEMENT AU COMPLEXE LA GRANDE),
Societe d'Energie de la Baie James, Montreal (Quebec).
D. Therrien.
Canadian Water Resources Journal, Vol 7, No 2, p 147-162, 1982. 6 Fig, 22 Ref.

Descriptors: *Environmental effects, *Reservoirs, Water resources development, Environmental protection, Natural resources, Bays, Dams, Canada, *James Bay Territory, Aesthetics, Recreation.

Increased concern about the quality of the environment has made it necessary for developers of natural resources to provide for protection of the environment and to respect the desires of the people affected. In developing the La Grande Complex, which comprises a series of dams, reservoirs, and canals to the east of James Bay in Canada, the Societe d'energie de la Baie James has had to fing original solutions to protect the integrity of the James Bay territory, avoid disruption of the traditional way of life practiced by the Amerindian populations in the area, and at the same time achieve the desired water resources management and hydroelectric power development goals. The first reservoir in La Grande Complex, LG 2, served as a trial area for the project. A variety of approaches were used to provide for protection of the biological quality of the environment and to allow use of the water bodies for both traditional and recreational activities. Other measures were designed to create a visually attractive environment near those sites likely to be visited. These corrective programs have been in operation at the LG 2 site since 1977. Although they are still being evaluated, information to date indicates that they have had a beneficial effect on the ecology of the area, minimizing the environmental harm caused by the project. Lessons learned at this site can be used to improve the development of future hydroelectric projects. (Carroll-FRC)
W83-04060

POLYCYCLIC AROMATIC HYDROCARBONS-ARE THEY A PROBLEM IN PROCESSED OIL SHALES,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 5B.
W83-04148

PARASITE COMMUNITIES AS INDICATOR SYSTEMS FOR PREDICTING THE EFFECTS OF SURFACE WATER MANAGEMENT OPTIONS ON THE BIOTA OF PRAIRIE RIVERS,
Nebraska Univ.-Lincoln. School of Life Sciences.
J. Janovy, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105535, Price codes: A02 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, September 1983. 15 p, 6 Fig. OWRT A-068-NEB(1), 14-34-0001-2129.

Descriptors: Ecology, *Ecological distribution, *Fish parasites, *Trematodes, Aquatic life, Microorganisms, Water management, Fish management, *Bioindicators, *Nebraska, Platte River, Plains killifish, Fundulus Kansae, Larval digenetic trematodes.

This study of the parasite community of the plains killifish, Fundulus kansae, in the Platte River system in Nebraska was conducted to determine whether this group of organisms would show population fluctuations associated with streamflow and human alterations of the river. Study sites included several both above and below a major irrigation diversion. Several parasite types, including myxosporidan and peritrich protozoa, monogenetic trematodes, and larval digenetic trematodes, were studied. The parasite community was described in terms of species diversity and parasite frequency distributions among the host population. It was shown that some types of parasites responded to annual streamflow changes, regardless of study site, while others had population structures which were relatively site specific, regardless of the annual river conditions. Larval digenetic trematodes were considered the best 'indicator species' to reflect aquatic bird use of a particular study site.
W83-04155

7. RESOURCES DATA

7A. Network Design

LANDOWNERS, RECREATIONISTS, AND GOVERNMENT: COOPERATION AND CONFLICT IN RED RIVER GORGE,
Kentucky Water Resources Research Inst., Lexington.
E. C. Scott, and B. R. DeWalt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255448, Price codes: A07 in paper copy, A01 in microfiche. Research Report No 134, June 1982. 228 p, 6 Fig, 44 Tab, 36 Ref, 4 Append. OWRT A-079-KY(1), 14-34-0001-1119/0119/9019.

Descriptors: *Recreation facilities, *Institutional constraints, *Statistical analysis, *Population density, *Riparian rights, *Public waters, Recreation demand, Surveys, Canyons, Land tenure, Data collections, Riparian land, Property rights, Water rights, Legal aspects, Data acquisition, Data interpretation, Public participation.

A holistic sociocultural user survey study was made of the Red River Gorge, a popular regional recreation site in eastern Kentucky, to provide a descriptive and analytic information to assist managers in more effectively understanding and coping with their work in this area. Innovative ideas/techniques were also developed for the study of recreationists. Density tolerance (DT) curves were constructed for recreationists; DT being an important component of the measurement of social carrying capacity of such recreational areas. The most important finding was the development of the idea of recreational niches (RN). The results demonstrate that recreational areas like the Gorge may contain many different RN that are used in very different ways from other recreational sites in the same general setting. Further, characteristics of visitors using any RN may be quite different from those of visitors using other sites. The presence of RN in an area may bias the data collection unless data are collected in all types of niches. Using only one niche as representative of the entire recreating populace can lead to erroneous predictions concerning visitor characteristics/preferences, and may lead to inappropriate management. The RN concept can also be used by managers to encourage/discourage certain types of users, knowing the Rn variety. (Zienlinski - MAXIMA)
W83-03903

7B. Data Acquisition

EVALUATION OF A GROUND TRANSIENT ELECTROMAGNETIC REMOTE SENSING METHOD FOR THE DEEP DETECTION AND MONITORING OF SALT WATER INTERFACES,
University of South Florida, Tampa. Dept. of Geology.
M. T. Stewart, and M. C. Gay.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253351, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 73, Univ. of Florida, Gainesville, July 1983. 47 p, 23 Fig, 43 Ref. OWRT A-046-FLA(1), 14-34-0001-2110.

Descriptors: *Geophysical surveys, *Salt water interfaces, Remote sensing, Coastal aquifers, Florida, Gulf Coast.

A ground transient electromagnetic sounding method was evaluated for the detection of salt water-fresh water interfaces along the Gulf Coast of FLorida. Seventy-nine sounding were completed utilizing either 80 x 80 meter or 160 x 160 meter horizontal transmitter coils. A 30 Hertz step function transmitter frequency was used. The decay of the vertical magnetic field was monitored over a period of 8 msecs during transmitter offtime. Measurements of the rate of decay of the magnetic field were converted to produce an apparent resistivity curve for each sounding. Computer produced theoretical curves were matched to the apparent resistivity curves. The results of this study are encouraging. The soundings compare favorably with chloride ion concentrations in area wells and with data from previous geophysical studies. An 80 x 80 meter coil is sufficient for sounding to depths of 250 meters. Depths and resistivities accurate to within plus-or-minus 10% of actual field values are possible. The transient electromagnetic method is safe, efficient, and economically attractive.
W83-03899

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF UNSATURATED SOILS WITH THERMOCOUPLE PSYCHROMETERS,
Texas Univ. at Austin. Geotechnical Engineering Center.
For primary bibliographic entry see Field 2G.
W83-04025

DETERMINATION OF SORPTIVITY BASED ON IN-SITU SOIL WATER REDISTRIBUTION MEASUREMENTS,
Southern Illinois Univ. at Carbondale. Dept. of Forestry.
For primary bibliographic entry see Field 2G.
W83-04044

AN IMPROVED THERMOCOUPLE HYGROMETER FOR IN-SITU MEASUREMENTS OF SOIL WATER POTENTIAL,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
O. Brunini, and G. W. Thurtell.
Soil Science Society of America Journal, Vol 46, No 5, p 900-904, September/October, 1982. 5 Fig, 15 Ref.

Descriptors: *Soil water, *Measuring instruments, Plant growth, Moisture availability, *Hygrometer,

Thermocouples, Water potentials, Plant water potential, *Soil water potential.

A new, improved thermocouple hygrometer for in situ soil water potential measurements is described which is based on the dewpoint theory and is operationally identical to the Neumann and Thurtell leaf hygrometer. The major design feature has been to minimize the temperature difference between the evaporating surface and the reference junctions. An initial test of the hygrometer in a soil-plant system and its performance when imposed on temperature gradients are evaluated. A porous silver membrane serves as the hydraulic connection between the soil and the measuring cavity, which encloses a four-terminal thermojunction made by cross welding chromel and constantan wires. The membranes were screwed to the copper body of the hygrometer; this configuration minimized the temperature difference between the vapor source and the reference junctions. When a thermal gradient was imposed on a hygrometer placed horizontally in a soil column, the maximum voltage offset observed was 0.05 microV, but the soil water potential values as indicated by the hygrometer readings remained constant at -0.56 MPa. The new device has a fast response for water flow with a time constant of about 5 min, and the time constant for salt diffusion in and out of the membranes is about 8 min. The device is able to follow changes in soil water potential very well, as demonstrated in soil water potential measurements under corn plant hybrid United 108 grown in a growth chamber environment. The difference in water potential noted between leaf and soil after the plant had been left several hours in the dark appeared to be related to uneven moisture distribution in the pot, and the plant was responding to the average soil water potential. (Baker-FRC)
W83-04070

ANALYSIS OF THE PLANT SOIL CONTINUUM USING ELECTROPHYTOGRAMS, PHASE II,
Arizona Univ., Tucson. Dept. of Electrical Engineering.
For primary bibliographic entry see Field 3F.
W83-04136

ANALYSIS OF CHEMISTRY ASSOCIATED WITH OZONOLYSIS OF ORGANIC POLLUTANT MOLECULES IN WATER,
Wesleyan Univ., Middletown, CT.
For primary bibliographic entry see Field 5A.
W83-04141

APPLICATION OF AERIAL PHOTOGRAPHIC AND COMPUTER ANALYSIS TO THE USLE FOR AREAWIDE EROSION STUDIES,
Texas Christian Univ., Fort Worth. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W83-04185

7C. Evaluation, Processing and Publication

FRACTURE TRACE MAPPING AND WATER WELL YIELD IN THE PIEDMONT REGION OF SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Civil Engineering.
D. B. Stafford, J. T. Ligon, and D. S. Snipes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255471, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 112, Clemson Univ. S.C., August 1983. 66 p, 5 Fig, 19 Ref. OWRT A-033-SC(1), 14-31-0001-5041-6042, 4041.

Descriptors: *Aerial photography, *Infrared imagery, *Remote Sensing, *Groundwater, *Well yield, Well water, Water supply, Water supply development, Igneous rocks, Metamorphic rocks, Geologic fractures, Mapping, Photography, Fracture permeability, *South Carolina, Piedmont.

This report describes the techniques and the results of an extensive program of lineament and fracture trace mapping in the Piedmont Region of South Carolina. The lineaments and fracture traces were mapped on a variety of aerial remote sensor products including color infrared Landsat imagery, black and white infrared Landsat imagery, Skylab color photographs, high altitude color and color infrared photographs, black and white aerial photographs, and photo index sheets. It was concluded that an analysis of different types of aerial remote sensor products is needed to accomplish a thorough fracture trance mapping program. Also, it was determined that numerous lineaments and fracture traces exist in each county of the South Carolina Piedmont Region. A cooperative well drilling program undertaken in an effort to correlate well yield with fracture trace location was not entirely successful. Also, attempts to correlate well yield and well location with respect to mapped linear features met with only partial success. A continuing program of working with cooperative well drillers in an effort to generate additional data relating well yield and fracture trace location and further research to correlate well yield and fracture trace location are recommended in the Piedmont Region.
W83-03906

THE USE OF LANDSAT MSS DIGITAL DATA IN WATER QUALITY MAPPING OF THE NEUSE RIVER ESTUARY, N. C.,
North Carolina State Univ. at Raleigh.
S. Khorram, and H. M. Cheshire.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256750, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 193, May 1983. 36 p, 10 Fig, 5 Tab, 22 Ref. OWRT A-125-NC(1), 14-34-0001-2135.

Descriptors: *Remote sensing, *Satellite technology, *Estuaries, Water quality, Data collections, Aerial photography, On-site data collections, Data interpretation, *Water quality standards, Salinity, Chlorophysll A, Suspended solids, Turbidity, Temperature, Regression analysis, Statistical models, *North Carolina, Neuse River, *Landsat data.

Landsat multispectral scanner (MSS) digital data, and high resolution anoramic photography obtained from the Environmental Protection Agency's Enviropod were combined with surface measurements for water quality mapping of the Neuse River estuary, North Carolina. This study constitutes the first effort to use Landsat digital data for mapping water quality parameters in this geographic area. The water quality parameters of interest included salinity, chlorophyll a, turbidity and total suspended solids. Temperature data were also recorded on site. The approach involved acquisition of water quality samples from boats at 75 sample sites simultaneous with Landsat satellite overpass. All of the remotely-sensed data and boat-acquired data were obtained from 8:45 A.M. to 9:50 A.M. local time on September 24 1982. Regression models were developed between each of the salinity and suspended solids measurements from boats and the MSS digital data. The coefficients of determination (R) were observed to be high for salinity and turbidity, relatively high for salinity and turbidity, relatively high for chlorophyll a, and medium for total suspended solids. No quantitative assessmeat could be made of the water quality parameters by visual interpretation of aerial imagery. The results include a series of color-coded maps, each pertaining to one of the water quality parameters, along with the statistical summaries.
W83-03918

WATER QUALITY MONITORING - RIVERS AND STREAMS, 1981.
Indiana State Board of Health, Div. of Water Pollution Control Report, 1981. 139 p, 6 Tab.

Descriptors: *Water sampling, *Water analysis, *Water measurement, *Water pollution, *Water pollution control, *Water pollution effects, Water quality management, Water quality, Biological samples, Chemical analysis, Chemical composition, State jurisdiction, Municipal water.

This is the twenty-fourth annual water quality report on the major surface waters of Indiana. The program was established to provide basic information on pollution trends and to provide water quality data for surface water users in Indiana. The importance of surface water is emphasized by the fact that two-thirds of the water usage in Indiana in 1980 was obtained from surface supplies. While 49 sites were sampled in 1957, 92 stations are included in the current program. Physical, chemical, and bacteriological analyses are made on samples collected from all 92 stations; plankton analyses from 18; and radiological analyses from 26. The monitoring program is intended to indicate, when possible, the sources of pollution entering a stream, to procure data useful for multiple users and for future pollution abatement programs, and to collect background data on certain types of wastes, such as chlorides and radioactive materials. The monitoring stations are selected on the basis of having waters used for municipal, industrial, agricultural and recreational purposes; if they are near known or suspected sources of pollution; and when they are near state boundaries to determine the quality of water entering or leaving the state. Routine samples include 2,000 milliliters for chemical analysis and about 100 milliliters in a sterile bottle for bacteriological analysis. This year no flow data are included. The forty-one methods of analysis used are described. (Garrison-Omniplan)
W83-03993

GEOLOGIC MAP OF REDWOOD CREEK DRAINAGE BASIN, HUMBOLDT COUNTY, CALIFORNIA,
Geological Survey, Miami, FL. Water Resources Div.
D. R. Harden, H. M. Kelsey, S. D. Morrison, and T. A. Stephens.
Open-File Report 81-496 (WRI), 1982. 1 Sheet, 23 Ref.

Descriptors: *Geologic mapping, *Geologic fractures, *Watersheds, *Geomorphology, Sedimentary rocks, Metamorphic rocks, Alluvium, Landslides, Erosion, *California, California Coast Ranges, Klammath Mountains.

A 1:62,500-scale geologic map with 14 rock stratigraphic units and an accompanying explanatory text are used to describe the geology of the Redwood Creek drainage basin of northwestern California. A large part of Redwood National Park is located in the downstream part of this actively eroding drainage basin. The bedrock consists primarily of Mesozoic sedimentary and metamorphic rocks. The structurally complex Franciscan assemblage of rocks underlies most of the basin, but rocks of the Klammath Mountain tectonic province occurs in a small eastern part of the basin. Most major boundaries between Mesozoic rock units are north-northwest trending faults parallel to the regional structural trend. Extensive areas of surficial coastal plain sediments, landslide deposits, stream terrace deposits and modern alluvium are also present; these areas help identify loci of vigorous recent erosion. (USGS)
W83-04012

A STATISTICAL ANALYSIS OF THE QUALITY OF SURFACE WATER IN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
R. A. Engberg.
Water-Supply Paper 2179, 1983. 252 p, 14 Fig, 9 Tab, 19 Ref.

Descriptors: *Water quality, *Surface water, *Chemical analysis, *Biological properties, Streamflow, River basins, Sampling, Sites, Water analysis, Regression analysis, Correlation analysis, Specific conductivity, Planning, Water quality control, *Nebraska.

This report provides descriptive statistics for 29 chemical or biological constituents for 109 stream sites in Nebraska sampled by the U. S. Geological Survey beginning in 1946. Also provided for each site are regression equations relating specific conductance to each of 12 chemical constituents and a regression equation relating specific conductance

to stream discharge. The descriptive statistics are presented by river basins. Water leaving these basins that has the lowest mean specific conductance (266 umho/cm) is from the Niobrara River at Verdel, and water that has the highest (1,890 umho/cm) is from the South Platte River at Roscoe. Statewide, the principal cations in streamflow are calcium and sodium, and the principal anions are bicarbonate and sulfate. Calcium and bicarbonate usually predominate where the mean exceeds 1,000 umho/cm. Based on regression equations, dissolved solids, hardness, calcium, magnesium and bicarbonate, with some exceptions, correlate well with specific conductance for all stream sites. Illustrations of how regression equations may be used to estimate water quality of streamflow are given and are compared with values from actual analyses. (USGS)
W83-04014

USE OF DIGITIZED RADAR AND MICROCOMPUTERS TO FORECAST LOCAL FLOODS AND IRRIGATION NEEDS,
Clemson Univ., SC. Dept. of Civil Engineering.
S. Nnaji, D. F. Linvill, and K. D. Robbins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105568, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 113, Clemson Univ., SC, June 1983. 80 p, 8 Fig, 2 Tab, 27 Ref, 1 Append. OWRT A-054-SC(1), 14-34-0001-2143.

Descriptors: *Microcomputer, *Radar, *Flood forecasting, *Irrigation scheduling, *Data collection, *Data storage and Retrieval, *Data transmission, Antecedent moisture, Excess rainfall, Rainfall rate, Discharge hydrographs, Decision making, Throughfall, Computer programs.

The objective is to develop an inexpensive microcomputer based system for making weather sensitive decisions in real time. The focus is toward the small scale weather information user. To this end the report describesa Radar Information Management System which uses a microcomputer to access, reformat, localize, store and retrieve radar rainfall (or other weather) data in a digitized form. The system will also produce a facimile on command. In addition to the system software, interactive applications software have been developed that will allow use of the system for local flood forecasting and assessment of irrigation needs given soil moisture predictions based on real time radar rainfall. A system implementation procedure and sample outputs are included.
W83-04158

8. ENGINEERING WORKS

8A. Structures

FINANCIAL ASPECTS OF DAM SAFETY,
International Bank for Reconstruction and Development, Washington, DC.
F. L. Hotes.
International Water Power and Dam Construction, Vol 35, No 1, p 37-38, January, 1983.

Descriptors: *Dam design, *Financing, *Safety, Dam construction, Dam stability, Economic aspects, Maintenance, Inspection, Monitoring.

In 1977, the World Bank updated its requirements for the design, construction, and inspection of dams that it helps to finance. The builders must have the concept and design of the dam reviewed by an independent panel of experts during the early and final stages of construction, and periodic safety inspections must be carried out by qualified independent experts. Adequacy of design includes the incorporation of appropriate monitoring equipment to check dam functions after construction. The cost of inspection panels may be considered for financing under the loan. A maintenance program may involve designing a manual of inspection directives and training a staff to carry them out. The use of a review panel has not been universally accepted in all nations, even in developed countries such as the United States. Sometimes the conclusions of the expert panel are not acceptable to the World Bank. Further discussions and inquiries might be required before a loan for a dam is approved. (Geiger-FRC)
W83-04078

LARGE CAPACITY BULB UNITS IN JAPAN,
Fuji Electric Co. Ltd., Kawasaki (Japan). Hydro Power Div.
For primary bibliographic entry see Field 8C.
W83-04166

EXPERIENCE IN THE USE OF ROLLED CONCRETE,
Ministry of Construction, Tokyo (Japan). River Bureau.
For primary bibliographic entry see Field 8F.
W83-04169

8B. Hydraulics

GROUND WATER PUMPING FROM SHALLOW AXISYMMETRIC PONDS,
Georgia Inst. of Tech., Atlanta. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W83-03863

MULTIPORT DIFFUSERS FOR HEAT DISPOSAL: A SUMMARY,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
G. H. Jirka.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY12, p 1425-1468, December, 1982. 25 Fig, 2 Tab, 47 Ref.

Descriptors: *Cooling water, *Diffusers, *Fluid mechanics, Powerplants, Mixing, Multiport diffusers, Thermal powerplants, Thermal water, Plumes, Water circulation, Stagnant water, Water currents, Stratified flow, Fate of pollutants, Wastewater disposal, Outfall, Nozzles.

The fluid mechanical characteristics of submerged multiport diffusers, used to disperse hot water discharges from thermal power plants, are reviewed. Near-field mixing of a thermal diffuser is strongly influenced by its momentum flux, whereas mixing of a sewage diffuser is governed by buoyancy flux. Unlike sewage diffusers, which form a buoyant plume, thermal diffusers produce instability in the near field, leading to a flow breakdown with local recirculation and full vertical mixing. The flow and temperature fields in the intermediate field depend on how the discharge momentum is introduced into the ambient fluid layer. Three major types of diffuser designs have evolved. The staged and unidirectional diffusers produce concentrated vertically mixed plume motions. The alternating diffuser generates a stratified flow field outside the unstable near field. Predictive techniques are given for the three types both for the stagnant ambient case and for the additional influence of a current system. A sample design is given for a 2000 MW nuclear power plant located in a site typical of the East or Gulf Coasts or the Great Lakes. For this problem the required diffuser length was greatest for alternating, least for unidirectional, and intermediate for staged. Impacts on the environment and mixing patterns are described for stagnant and running water. (Cassar-FRC)
W83-03864

SEDIMENTOLOGY OF ERECT VEGETAL FILTERS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
E. W. Tollner, B. J. Barfield, and J. C. Hayes.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY12, p 1518-1531, December, 1982. 10 Fig, 1 Tab, 18 Ref.

Descriptors: *Sediment transport, *Vegetation effects, *Filter media, Grasses, Model studies, Channel flow, Shear, Bed load.

A method for calculating the steady state sediment transport rate through a vegetated channel was developed using an analogy between a narrow deep open channel and flow through closely spaced erect objects. A dimensionless bed shear parameter was predicted using a spacing hydraulic radius in which media spacing was substituted for channel width. This shear parameter was used in Einstein and Graf sediment transport equations and in Neil's relationship to describe the initiation of sediment motion. Correlation values were 0.81-0.94. Predicted and observed values for movement of sediment in grasses agreed very well. (Cassar-FRC)
W83-03865

HYDRAULICS AND NUMERICAL SOLUTIONS OF STEADY-STATE BUT SPATIALLY VARIED DEBRIS FLOW,
Utah Water Research Lab., Logan.
A. A. DeLeon, and R. W. Jeppson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256719, Price codes: A06 in paper copy, A01 in microfiche. Hydraulics and Hydrology Series UWRL/H-82/03, July 1982. 95 p, 24 Fig, 10 Tab, 35 Ref. OWRT A-053-UTAH(1), 14-34-0001-1147.

Descriptors: *Debris flow, *Open channel flow, Mud flow, *Flow density, *Flow viscosity, Energy loss, Fluid mechanics.

The debris flows that occur periodically in steep, narrow mountain canyons are very destructive. Engineered design and land use management in affected areas requires quantification of flows and inundated areas through hydraulic formulas. Specifically, debris flow is triggered by high intensity rainfall, loose surface material available for transport, slopes steep enough to induce flowage, and insufficient vegetation. The two hydraulic models currently available (Bingham plastic model and dilatant model) were found to be not very useful in practice. According to field data, most debris flows are laminar because of viscosities as high as 600,000 times that of water. A theoretical derivation starting from the Saint-Venant equations of continuity and motion, when combined with a modified Chezy equation, C=1.85 R sub e super 0.52, for defining the energy loss, gave a relationship, rho/mu = 3/R, found suitable. These equations successfully applied to four examples situations by numerical methods implemented in a computer program. The examples were all steady but gradually varied debris flow situations. The bed slope was found to be the most important variable affecting the ratio of debris flow to water flow depth with ratios for mild slopes exceeding 10.
W83-03914

JOHNSON VELOCITY METER SYSTEM PROVES ITS WORTH,
UOP, Inc., St. Paul, MN. Johnson Div.
D. C. Larson.
Johnson Driller's Journal, Vol 53, No 1, p 6-7, 1981. 1 Fig.

Descriptors: *Pumping tests, *Aquifer testing, *Flow velocity, Well yield, Measuring instruments, Flow measurement.

The Johnson velocity meter system is a turbine-type flowmeter used to measure vertical flow velocity in pumping wells. A flow vs. depth graph shows the upper and lower limits of the water bearing formation. Use of the tool is illustrated in a water well velocity survey conducted in a well 315 ft deep. In this case the most productive zone was between 205 and 235 feet. (Cassar-FRC)
W83-04076

8C. Hydraulic Machinery

BIPHASE TURBINE FOR REVERSE OSMOSIS DESALINATION,
Transamerica Delaval, Inc., Santa Monica, CA. Biphase Energy Systems.
P. L. Limburg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255513,

Price codes: A04 in paper copy, A01 in microfiche. Completion Report, December 1982. 49 p, 18 Fig, 7 Tab, OWRT C-10121-S(No 1487)(1), 14-34-0001-1487.

Descriptors: Power recovery, *Turbines, *Reverse osmosis, Hydraulic turbines, *Desalination, Turbine efficiency.

A new hydraulic reaction turbine was designed to recover the power available in the high-pressure waste-brine stream of reverse osmosis desalination systems. A reaction turbine sized for reverse-osmosis systems producing 600 gph was built and tested. The turbine performed well driving either a variable-speed pump or an electrical generator. Measured turbine efficiency (shaft power divided by available power) was 63%, compared with a prediction of 67%. The turbine can be built with larger capacity to reduce the size, weight and power consumption of reverse osmosis desalination systems. Efficiency of larger units is predicted to lie in the range of 65 to 70%.
W83-03910

MULTIPORT DIFFUSER DESIGN FOR DISCHARGING POLLUTANTS IN ALABAMA'S RIVERS,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
A. D. Parr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256693, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Auburn Univ., Ala., April 1983. 6 p. OWRT A-077-ALA(2), 14-34-0001-0101.

Descriptors: *Diffusion coefficient, Environmental effects, *Mathematical models, Plumes, Rivers, Water pollution, *Wastewater disposal, *Flow discharge, *Alabama.

A laboratory study was conducted to measure surface temperatures downstream from a submerged multiport river diffuser. An empirical equation was developed which considers the physical variables and predicts downstream temperatures. The flowfield induced by a submerged multiport diffuser discharging across part of the width of a river was considered. A mathematical model was formulated for the flow in the nearfield region of a diffuser plume centered in a rectangular channel. The model was used to determine nearfield dilution as a function of effluent and ambient flow parameters. A family of dilution curves was presented for a range of conditions characteristic of prototype river diffusers. A method was given for applying the mathematicl model to diffuser-induced flow-fields in rivers. The model was also compared with measurments made in the Mississippi River downstream from the Quad Cities Nuclear Power Station diffuser. Design procedures to optimize finite length river diffuser performance were developed. Computer programs were written to facilitate necessary design calculations.
W83-03912

MECHANICAL CLEANING EQUIPMENT FOR STORMWATER BASINS (MASCHINELLE RAUMEINRICHTUNGEN FUR REGENBECKEN),
Rheiner Machinenfabrik Windhoff A.G. (Germany, F.R.).
R. Wischner.
Wasser, Luft und Betrieb, Vol 24, No 6, p 16, 18-20, June, 1981. 5 Fig, 6 Ref. (No English Summary).

Descriptors: *Storm water, *Retention basins, *Cleaning, *Hydraulic equipment, *Detention reservoirs, Storm runoff, Insects, Odor control, Rain basins, Cleaning equipment, Sprays, Design criteria, Water pollution control, Construction materials, Reservoirs, Storage tanks, Maintenance, Basins, Closed basins.

Cleansing systems for rainwater collection, overflow, and treatment basins are described. In principle, a self-cleaning basin is preferred, but high construction costs (e.g., for floor profiling) and the need for the surrounding terrain to meet certain hydraulic conditions make mechanical cleaning more practical. The deposited matter to be removed is mostly of mineral origin (e.g., sand, gravel) but contains variable amounts of organic matter. When the basin is dry, the deposits soon decompose, resulting in malodorous conditions. Thus it is necessary for cleaning equipment to start operating automatically immediately after rainfall begins and the water level rises. The cleaning plates are a determining factor for performance level: for rectangular basins, heavy sheet-steel, plough-shaped plates with rollers or skids are employed; while for round basins, because deposits must be removed via a central funnel, steel plates with a logarithmic spiral or fan shape are required. Since the cleaning plates cannot remove floating matter that adheres to the basin walls, and because sludge residues can remain on the basin floor after cleaning, a supplemental spray cleaning device is essential. To ensure that the cleaning system starts up at the appropriate time, a water-level-dependent control system must be used. A second control system is required to switch the cleaners on periodically during dry spells (to prevent odors and flies). For closed rectangular rain basins, longitudinal cleaners attached to a continuous cable line are used. The entire cleaner is under ground and runs on a track along the basin sides. For round basins, an underground cleaner with central drive mechanism mounted above the basin on a bridge is used. For large round basins with a central concrete support, the drive mechanism is located decentrally. (Gish-FRC)
W83-03942

WATER CONTROL BY AUTOMATIC GATES,
U. Berar.
International Water Power and Dam Construction, Vol 35, No 1, p 35-37, January, 1983. 3 Fig, 1 Tab.

Descriptors: *Mathematical models, *Hydraulic gates, *Weirs, *Irrigation canals, Model studies, Mathematical studies, Canals, Hydraulic equipment, Hydraulic machinery, Automation.

A mathematical model simulating the movement of an automatic gate operating at a constant upstream level and under differing water demands is being developed in Romania. This model will lead to a more detailed knowledge of the process which takes place in the canal section close to the gate zone and allow improvements to be made in the mechanism or the operating regime of the canals equipped with automatic gates. The model elaborates conditions similar to reality and is based on the average state of the system for calculating the essential balance of energy involved in the process, assuming that a certain general relationship exists between the balanced terms. This model simulating the movement of the hydraulically adjusted gated weir is a useful tool in dimensioning of water delivery systems. When the model is applied in choosing a weir type and monitoring its effects during operation, the calculations must be carried out by a computer. (Geiger-FRC)
W83-04079

LARGE CAPACITY BULB UNITS IN JAPAN,
Fuji Electric Co. Ltd., Kawasaki (Japan). Hydro Power Div.
T. Ueda.
International Water Power and Dam Construction, Vol 35, No 3, p 19-24, 1983. 10 Fig, 1 Tab, 2 Ref.

Descriptors: *Hydroelectric power, *Economic aspects, *Dam design, *Turbines, *Damsites, *Electrical equipment, Dam construction, Hydraulic equipment, Dams, *Tidal powerplants, *Japan.

Few economically favorable hydropower sites remain in Japan. However, if small plants of less than 10 MW capacity were to be exploited, then 5400 MW might be developed over the next ten years. The Akao power station typifies an economical low-head site. Its dam impounds 600,000 cu m of the Sho river and utilitizes a bulb turbine. The Sakuma 2 station was constructed to exploit a 15.5 m head. Its powerhouse is partially underground, and two vertical upper and lower stayvanes and four auxiliary stayvanes support the bulb in which the generator is housed. The Shingo 2 station, constructed in parallel with the existing Shingo station on the Agano river, has a mximum capacity of 38.8 MW at a maximum discharge of 200 cu m/sec. The generating unit has a record-breaking high-head large-capacity bulb turbine, and the structural design of the turbine and generator is basically the same as that of the Akao station. The technology of large-capacity bulb turbines and generators may be exploited in the future for the development of tidal power generation. (Geiger-FRC)
W83-04166

OPTIMUM CAPACITY OF A RUN-OF-RIVER PLANT,
International Engineering Co., Inc., San Francisco, CA.
F. Fahlbusch.
International Water Power and Dam Construction, Vol 35, No 3, p 45-48, 1983. 3 Fig.

Descriptors: *Stochastic process, *Mathematical studies, *Model studies, *Optimization, *Decision making, *Hydroelectric power, Stochastic hydrology, Prediction, Planning, Hydroelectric plants, Streamflow, Monte Carlo method.

A run-of-river plant may be viewed as a system which converts a stochastic input process, streamflow, into a stochastic output process, power. As a result of the stochastic nature, an approach is needed to determine the capacity which allows for uncertainty, especially where decision making involving risks must be used. An approach is introduced which provides an exact formulation which is simple to implement and provides valuable guidance in weighing the possible effects of imprecise cost and benefit data on the design capacity. The objective function has the typical structure of the objective functions describing single-period inventory decision problems under risk. The theory and results may be applied to any hydro plant, with or without pondage, if the objective is maximum exploitation of energy and not provision of peak capacity. A maximization of net benefit is used as evaluation criterion. Equations are derived which provide sufficient conditions for determining the optimum capacity, whether or not the project as a whole exhibits a favorable economic performance. The Monte Carlo method was used to extend the method by simulating hypothetical projects for smaller watersheds. (Geiger-FRC)
W83-04167

CHARACTERISTICS OF GENERATORS FOR SMALL CAPACITY SCHEMES,
Meidensha Electric Mfg. Co. Ltd., Tokyo (Japan). Hydraulic Power Generation Div.
S. Miyakawa.
International Water Power and Dam Construction, Vol 35, No 3, p 36-40, 1983. 6 Fig.

Descriptors: Electrical equipment, *Hydroelectric plants, *Hydraulic turbines, Hydraulic machinery, Hydraulic equipment, Construction costs, Turbines, *Thailand, *Indonesia.

Horizontal type turbine-generators are being used increasingly for small scale hydro to reduce construction costs and to simplify the layout of equipment and construction. These types of generators have stator coils insulated by an r.t. insulation system which uses vacuum pressure impregnation. Their standard exciting system is the brushless type, and the generator bearings are designed to support the hydraulic thrust force and the weight of the turbine runner. Rotors can be of the salient pole type or the cage type. The main shaft is made of rolled or forgeu steel, and the flywheel is made of steel plate or cast steel. The guide bearings and thrust bearings are installed together on the direct coupling side. Where a two-bearing type is adopted, a brake unit is installed between the exciter and the outside of the bearing. The brushless exciter is a current trend for easy maintenance. The Batang Agam station in Indonesia and the Mae Kum Luang station in Thailand are two horizontal type turbine-generator units currently in operation. (Geiger-FRC)
W83-04168

THE PROBLEMS AND BENEFITS OF SMALL-SCALE HYDRO (PART 2).
For primary bibliographic entry see Field 6C.
W83-04170

8D. Soil Mechanics

MATERIAL FOR EMBANKMENT DAMS,
A. D. M. Penman.
International Water Power and Dam Construction, Vol 35, No 1, p 15-19, January, 1983. 2 Fig, 24 Ref.

Descriptors: *Rock fill, *Earth dams, *Dam design, *Dam foundations, Rockfill dams, *Embankments, *Mine wastes, Soil mechanics, Dams, Dam construction, Earthworks, Materials engineering, Fly ash.

Embankment dams remain the most frequently built dams today due to their low construction costs and aesthetic properties. Rockfill material is usually more suitable for higher embankment dams. Modern rockfill, placed in layers and compacted by vibrating, ensures minimum contact forces by providing abundant fines. Control of rockfill placement is measured by the compaction meter. The shear strength of rockfill is defined by the angle of shearing resistance. The use of rockfill has made upstream membrane dams popular. Well graded sand and gravel can provide good shoulder fill, as illustrated by new rockfill dams in the Soviet Union, Canada, and Scotland. Earthfill of soft silty clay is often used for the shoulders of dams. A combination of weak shoulder fill and low-strength foundation can lead to the formation of very flat slopes, which may be used for farming or other purposes. Embankment dams have traditionally been fitted with cores of compacted earthfill of low permeability, such as bituminous concrete. Waste materials such as metal tailings, fly ash, and furnace bottom ash have also been used for embankment dam materials. Embankment dam behavior has been analyzed by numerical models, finite element techniques, and one-dimensional compression tests. (Geiger-FRC)
W83-04081

10

THE USE OF GEOTEXTILES IN FRENCH EARTH DAMS,
Ministere de l'Agriculture, Paris (France).
D. Loudiere, D. Fayoux, J. Houis, J. Perfetti, and M. Sotton.
International Water Power and Dam Construction, Vol 35, No 1, p 19-21, January, 1983. 4 Fig, 2 Tab.

Descriptors: *Earth dams, *Dam design, *Earthworks, *Soil filters, *Performance evaluation, Dam construction, Dams, Materials engineering, Soil mechanics, Filters, Dam stability.

Geotextiles are used in earth dam construction to guard contamination and for filtration, drainage, strength, containment, and separation. Geotextile materials may be classified as woven or non-woven materials or composite geotextiles. Durability tests of various geotextiles were conducted on samples taken from two earth dams in France. For all civil engineering applications, after ten years' use, the reduction in mechanical performance of geotextiles was not more than 30% under normal use conditions. The French Committee on Geotextiles has drafted a matrix table to classify properties of geotextiles according to tensile strength, elongation load, and tear strength. When geotextiles are used as filters, some designers recommend tests to demonstrate that there is no incompatibility between the geotextile and the soil. Since these tests are time-consuming, it is often more logical to use filter rules based on the intrinsic properties of the geotextile and the soil. Interim rules based on an analogy with Terzaghi's rules and long-term tests at Cemagref are suggested; these do not apply to gap-graded, evolutive or dispersive soils. Other areas in which geotextiles may contribute to good dam performance relate to cracking, earthquake-resistance and rapid drawdown. (Geiger-FRC)
W83-04082

8F. Concrete

ASPHALTIC CONCRETE MEMBRANES IN EMBANKMENT DAMS,
Binnie and Partners, London (England).
R. A. Bunn.
International Water Power and Dam Construction, Vol 35, No 1, p 22-24, January, 1983. 4 Fig, 4 Ref.

Descriptors: *Dam construction, *Concrete dams, *Dam design, *Embankments, *Concrete technology, Dam foundations, Asphalt, Membrane filters, Rockfill dams, Earth works, Dam stability.

Bituminous materials have been successfully used for many years as waterproofing structures in embankment dams. Asphaltic concrete membranes are costly but durable and have withstood the effects of sun and high temperatures as well as frost and low temperatures. The face length which can be laid from one working elevation is limited to about 150 m. The outer face of the embankment should be constructed on a crushed, well graded, permeable rockfill. The first layer of asphaltic concrete is a leveling and binder course. In the 1950's and 1960's, monitoring of leakage was done by placement of a drainage layer, and a seal coat was applied to the facing to protect against the elements. The toe structure should be kept as low as possible above the adjacent embankment foundation level, and it may contain a drainage gallery to monitor seepage. Construction of the facing is done in conjunction with weather conditions. Seven dams over 50 m in height have been constructed with a dense asphaltic core as the sole waterproofing membrane. Transition material on either side of the core creates a stable working surface for the construction plant and binds the core to the coarser embankment fill. Two machines have been developed to construct the cores. Each delivery of the constituent materials should be tested for physical properties. For facing membranes, the stability of the dense mix should be checked at regular intervals. (Geiger-FRC)
W83-04083

EXPERIENCE IN THE USE OF ROLLED CONCRETE,
Ministry of Construction, Tokyo (Japan). River Bureau.
T. Hirose.
International Water Power and Dam Construction, Vol 35, No 3, p 40-44, 1983. 5 Fig, 3 Tab, 5 Ref.

Descriptors: *Dam construction, *Concrete technology, *Concrete dams, *Construction methods, Construction materials, Gravity dams, *Japan, Concrete, Dam design, Construction costs.

The construction of modern concrete dams in Japan has been practiced for over one hundred years due to improvements in construction equipment, rationality of design, and the suitability of materials. In 1974, a Committee on Research Concerning Rationalized Construction of Concrete Dams was established, and in 1978, study groups were formulated to examine the rolled concrete method for the construction of the Shimajigawa and Ohkawa dams. Problems with the construction of concrete dams in Japan include crack formation, labor problems, and an abundance of cement unsuitable for dam construction. During the construction of the Shimajigawa dam, a stationary cableway and dump trucks were used due to topographical limitations. By using the rolled concrete method in constructing the Ohkawa dam, a three to four times greater unit placement volume could be achieved compared with the conventional block method. The control of moisture content was facilitated by radioisotopes during dam construction. Labor costs were reduced by the use of machinery. At the raising of the Shin-Nakano dam, the rolled concrete method was chosen for its economy and ease of placement. The rolled concrete method may be suitable for the construction of gravity dams if certain problems are solved. The River Bureau of the Ministry of Construction is currently investigating this method of construction. (Geiger-FRC)
W83-04169

8G. Materials

LEVASINT COATINGS. LONG-TERM CORROSION PREVENTION INCLUDES THE WATER FIELD (LEVASINT-BESCHICHTUNGEN. LANGZEIT-KORROSIONSSCHUTZ AUCH FUR DEN WASSER-BEREICH),
Bayer A.G., Leverkusen (Germany, F.R.).
J. A. Aziz El Sayed.
Wasser, Luft and Betrieb, Vol 25, No 3, p 34-35, March, 1981. 4 Fig, (No English Summary).

Descriptors: *Coatings, *Pipes, *Water tanks, *Corrosion control, Wastewater treatment, Water treatment, *Levasint coating, Metals, Linings, Corrosion, Deterioration, Standards, Physical properties, *Federal Republic of Germany.

The physical properties, methods of application, and areas of use for Levasint a corrosion preventive coating for metal equipment, are described. Levasint coating is especially suited to use in the water and wastewater treatment fields, since it poses no health hazards. Levasint is a powder based on an ethyl-vinyl alcohol copolymer and contains no additives other than pigments. It has been used successfully for over 10 yr. Before application, the metal surfaces to be coated should be roughened by blasting with a sharp-edged medium. Methods of applying Levasint include the centrifugal sintering procedure, spraying with a powder spray gun, flame spraying, and the filling and rotation sintering methods. Levasint coating adheres well to metal surfaces and conforms to the Federal Republic of Germany's standards for use in the food and drinking water industries. It does not promote the growth of bacteria and microorganisms and is wear-resistant, so that water with a high solids content does not damage it. Its smooth surface prevents incrustation. It can be used with water of pH 1-14, and in underground applications has proved not to be affected by soil composition. The coating provides metal equipment with good electrical insulation. Levasint has been used in sludge and aeration basins for over 10 yr and in the general wastewater treatment area for over 5 yr. It is also used for equipment in drinking and industrial water treatment. (Gish-FRC)
W83-03939

EMBANKMENT DAMS WITH POLYETHYLENE AND STEEL MEMBRANES,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Moscow (USSR).
V. D. Glebov, and V. S. Kuznetsov.
International Water Power and Dam Construction, Vol 35, No 1, p 25-28, January, 1983. 4 Fig, 3 Ref.

Descriptors: *Embankments, *Dam construction, *Polymers, *Impervious membranes, *Materials engineering, *Steel, Dams, Dam design, Membranes, Materials testing, Performance evaluation, Waterproofing.

Polymer film watertight elements are becoming major materials for waterproofing embankments due to their substantially lower cost, reduced labor requirements, and ease of handling. The Atbashi dam and the Tortgul reservoir of the Soviet Union employ polymer film waterproofing. Required film element thickness is calculated from soil grain size for a continuous foundation and from flexure of girderless slabs or membrane behavior for a discrete foundation. Film elements are subject to additional tensile stresses induced by foundation settlement, cracks or other internal defects. Polyethylene films are used as watertight blankets in the Soviet Union to withstand sub-zero temperatures. The use of steel membranes at Serebryanskaya-2 and Norilskaya dams has allowed the dams to operate reliably for years in sub-zero temperatures. Special corrosion protection prolongs the life of steel membranes in dams. Procedures were developed for stress analysis and for calculating the membranes' horizontal movements. Experience gained during construction has led to recommendations for installing different membrane types and for placing soil into the side shells and filter zones of dams. (Geiger-FRC)
W83-04077

THE SEISMIC BEHAVIOUR OF GRAVITY DAMS FOUNDED ON LOW SHEAR STRENGTH SOIL,
Engineering and Consulting Co., Belgrade (Yugoslavia). Dept. of Underground Structures.
I. V. Tucovic.
International Water Power and Dam Construction, Vol 35, No 1, p 28-31, January, 1983. 5 Fig, 5 Ref.

Descriptors: *Dam stability, *Seismic properties, *Materials engineering, *Concrete dams, Gravity dams, Dams, Dam construction, Earthquake engineering, Clays, Polymers, Dam foundations.

The need for energy and large fertile areas with water control often forced engineers to place gravity dams in seismis zones having foundation soils characterized by low shear strength. For gravity dams, the acceptable siesmic effect should be based on the amount of differential movement which will not jeopardize the structural integrity of the dam. This should include the maximum credible earthquake conditions based on the relevant earthquake record for the dam location. The contact surfaces between the monoliths and the embankment represent the most delicate part of the dam. Joint fillers must be selected to ensure proper placement, have a small resistance to volume changes, and contribute to water tightness. Bentonite and polystyrene may be used as joint fillers, but the latter disintegrates with time. Typical contact surfaces which are already in operation are discussed. Contacts within the concrete parts in a dam in Iraq feature a bentonite plug sealer and two polyvinyl chloride waterstops. A joint between the contact headwork and chute contains a copper sheet waterstop and a protective cap of stainless steel. A circular bentonite cushion and a polyvinyl chloride waterstop provide a sealing for the junction of the concrete dam and access shaft which can accommodate differential movements. The upper part of the shaft is reinforced against asymmetric bentonite pressure which could occur during sliding. (Geiger-FRC)
W83-04084

A U.S. TEST FOR INSITUFORM; OR, HOW TO REBUILD PIPE FROM WITHIN,
South Daytona Dept. of Building and Engineering, FL.
R. Owens.
American City and County, Vol 95, No 9, p 40-41, September, 1980.

Descriptors: *Sewers, *Repair, *Insituform, *Infiltration, Daytona Beach, Florida, Soil water movement, Maintenance, Pipes.

Due to the high water table, infiltration is a major problem in sewer systems of Daytona Beach and South Dayton, Florida. Having found through cost estimates that slip lining would be too expensive a method to restore sewer lines, the installation of Insituform was agreed upon. The job involved lining 2455 ft of 15-in pipe, 3616 ft of 12-in pipe and reconnecting 112 service laterals. The process uses a flat, flexible polyester fiber belt tubing, lined on one side with polyurethane and impregnated with a liquid, thermal-setting catalyzed resin at the time of installation. Before it is injected into the liner, resin is mixed with peroxide. The prewetted liner is fed to the top of scaffold from a truck. As the liner is fed through an inversion tube, a cover protects it from the direct rays of the sun. Curing is an important factor, with a 15-in line, 300 ft long, taking about 16 hr to cure completely. After curing, lateral connection cutting is mnitored. Renewal of the system took 3 months' time and reduced the flows to the treatment plant by more than 200,000 gpd. The cost was $265,000. (Baker-FRC)
W83-04130

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

HYDROLOGIC STUDIES OF THE U. S. GEOLOGICAL SURVEY IN MAJOR COAL-RESOURCE AREAS OF UTAH THROUGH 1980,
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. C. Lines.
Open-File Report 81-216, February 1981. 20 p, 4 Fig, 1 Plate.

Descriptors: *Bibliographics, *Surface water, *Groundwater, *Coal mining, Groundwater availability, Data collections, *Utah.

Hydrologic studies in and near the major coal fields of Utah by the U.S. Geological Survey through 1980 are described. The report is intended as a reference for those people dealing with coal-related hydrologic problems. In an annotated bibliography, 47 reports that deal with many components of the hydrologic system are summarized. Most of the reports are interpretive in nature, but some contain only basic data. The reports deal with such varied subjects as the magnitude and frequency of floods, the availability of ground water, and the hydrologic impacts of coal mining. Seven hydrologic studies that are active in 1980 in Utah coal-resource areas are described. That part of the Geological Survey statewide network for monitoring surface water and ground water that is in the vicinity of the major coal fields also is described. (USGS)
W83-04015

SUBJECT INDEX

ACCUMULATION
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

ACETYLCHOLINESTERASE
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

ACID MINE DRAINAGE
Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

ACID RAIN
Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

1982 Stockholm Conference on Acidification of the Environment,
W83-04095 5B

Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

ACIDIC WATER
Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

Low pH and the Absence of Fish Species in Naturally Acidic Wisconsin Lakes: Inferences for Cultural Acidification,
W83-04108 5C

ACTIVATED CARBON
Biological Regeneration of Activated Carbon,
W83-04133 5D

ACTIVATED SLUDGE
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

ACTIVATED SLUDGE PROCESS
The Jet Nozzle--A New Submerged Aerator (Die Strahlduse--Ein Neuer Tauchbelufter).
W83-03926 5D

Effective Use of STOM,
W83-03931 5D

Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

ACTIVATED SLUDGE PROCESSES
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

ADSORPTION
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

ADVANCED WASTEWATER TREATMENT
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

AERATION
Energy-Efficient Aeration of Activation Basins (Energiefreundliche Beluftung Von Belebungsbecken),
W83-03925 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

AERATORS
The Jet Nozzle--A New Submerged Aerator (Die Strahlduse--Ein Neuer Tauchbelufter).
W83-03926 5D

AERIAL PHOTOGRAPHY
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

AEROBIC DIGESTION
Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

AEROBIC TREATMENT
Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

AGRICULTURAL RUNOFF
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

AGRICULTURAL WATERSHEDS
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

AGRICULTURE
Some Aspects of the Present Status of Algae Cultivation and Their Application (Nekotorye Aspekty Sovremennogo Sostoyaniya Kul'Tivirovaniya Vodoroslei I Ikh Primenenie),
W83-04073 5D

Purification of Faecal Waters Combined with Algal Protein Production (Ochistvane Na Vodi S Fekalen Kharakter, Suchetano S Poluchavane Na Vodoraslov Protein),
W83-04074 5D

Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

AIR POLLUTION
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

ALABAMA
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

ALGAE
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

Some Aspects of the Present Status of Algae Cultivation and Their Application (Nekotorye Aspekty Sovremennogo Sostoyaniya Kul'Tivirovaniya Vodoroslei I Ikh Primenenie),
W83-04073 5D

Purification of Faecal Waters Combined with Algal Protein Production (Ochistvane Na Vodi S Fekalen Kharakter, Suchetano S Poluchavane Na Vodoraslov Protein),
W83-04074 5D

Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

ALGAL BIOASSAY
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

ALGAL GROWTH STAGES
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

ALGAL TOXINS
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

ALUMINUM
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

AMMONIA
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

ANAEROBIC DIGESTION
Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

AQUATIC BIOTA
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

AQUATIC HABITATS
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

AQUATIC INSECTS
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

AQUATIC LIFE
Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

AQUATIC PRODUCTIVITY
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

AQUIFER
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

AQUIFER CHARACTERISTICS
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

Estimation of Aquifer Transmissivities Using Numerical Models,
W83-04157 2F

AQUIFER MANAGEMENT
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

The Contamination and Protection of Aquifers,
W83-04020 5B

AQUIFER PROPERTIES
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

AQUIFER TESTING
Johnson Velocity Meter System Proves its Worth,
W83-04076 8B

ARID LANDS
Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

ARID-ZONE HYDROLOGY
A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

ARIZONA
Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

Residual-Wax Soil Treatments for Water Harvesting,
W83-04038 3B

Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

Estimation of Aquifer Transmissivities Using Numerical Models,
W83-04157 2F

AROMATIC COMPOUNDS
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

AROMATIC HYDROCARBONS
Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

ASBESTOS
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

ATTITUDES
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

AUSTRALIA
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

Plankton of the Lower River Murray, South Australia,
W83-03892 5C

Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

AUTOMATION
Discrete-Time, Cutback Furrow Irrigation,
W83-03958 3F

The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

BACTERIA
Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

BACTERIAL ANALYSIS
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

BANK STORAGE
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

BARITE
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

BARIUM
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

BARRIERS
Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

BATON ROUGE
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

BEACHES
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

BELGIUM
The Jet Nozzle--A New Submerged Aerator (Die Strahldüse--Ein Neuer Tauchbelufter).
W83-03926 5D

BENEFITS
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

BENTHIC FAUNA
Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

BIBLIOGRAPHICS
Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

BIGHTS
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

BIOASSAYS
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

BIODEGRADATION
Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

BIOFILMS
Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

BIOINDICATORS
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

BIOLOGICAL FILTER
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

BIOLOGICAL PROPERTIES
A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

BIOLOGICAL TREATMENT
Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

BIOLOGICAL WASTEWATER TREATMENT
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

Biological Regeneration of Activated Carbon,
W83-04133 5D

Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

BIOMANIPULATION
Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

BIOMASS
Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

BISULFITE
Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

BORDER IRRIGATION
Border Ditch Irrigation in Colorado,
W83-03959 3F

BORON
A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

BRACKISH WATER
Desalting Water in Florida,
W83-04196 3A

BRINES
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

BRITISH COLUMBIA
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

BROMEGRASS
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

BROMIDES
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

CADMIUM
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

CALCIUM
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

CALIFORNIA
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

Clarifying Geothermal Fluids,
W83-04052 5F

CARBONATE DETERGENT
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

CARCINOGENS
Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

CASPIAN SEA
Optimal Control of the Caspian Sea Level,
W83-03949 4A

CELLULOSE ACETATE MEMBRANES
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

CHANNEL FLOW
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

CHELATION
Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

CHEMICAL ANALYSIS
A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

CHEMICAL OXIDATION
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

CHEMICAL OXYGEN DEMAND
Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

CHEMICAL PROPERTIES
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

CHEMICAL WASTEWATER
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

CHEMISTRY OF PRECIPITATION
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

CHINA
Agricultural Meteorology in China,
W83-03851 2B

CHLORELLA
Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

CHLORINATED HYDROCARBONS
Analysis of Chemistry Associated With Ozonolysis of Organic Pollutant Molecules in Water,
W83-04141 5A

Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

CHLORINATION
Reducing the Formation of Trihalomethanes,
W83-03997 5F

Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

CHLORINE
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

CHLOROFORM
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

CHLOROPHENOLS
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

CHLOROPHYLL
Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

CHLOROPHYLL A
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

CHLOROPHYTA
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

CHROMATOGRAPHY
Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

Determination of Deuterium Oxide in Water by Reversed-Phase High-Performance Liquid Chromatography,
W83-04190 5A

CLARIFICATION
Clarifying Geothermal Fluids,
W83-04052 5F

Deep Tank Aeration/Flotation, Clarification Adds a New Treatment Dimension,
W83-04085 5D

Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

CLARIFIERS
Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

CLASSIFICATION
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

CLAYS
The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

CLEANING
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

CLEAR-CUTTING
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

CLOGGING
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

CLOSTRIDIUM PERFRINGENS
Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

COAL GASIFICATION
Coal Conversion Solid Waste Disposal,
W83-03858 5E

COAL LIQUEFACTION
Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

COAL MINE WASTES
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

COAL MINING
Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

COATINGS
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

COLIFORMS
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

COLLOIDS
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

COLORADO
Border Ditch Irrigation in Colorado,
W83-03959 3F

COLUMBIA RIVER
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

COMBINED SEWER OUTFLOWS
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

COMBINED SEWER OVERFLOWS
Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

COMPOSTING
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

COMPUTER MODELS
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

COMPUTER PROGRAMS
Computer Aid for Terrace Location,
W83-03957 4D

CONCRETE DAMS
Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

Experience in the Use of Rolled Concrete,
W83-04169 8F

CONCRETE TECHNOLOGY
Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

Experience in the Use of Rolled Concrete,
W83-04169 8F

CONFERENCES
1982 Stockholm Conference on Acidification of the Environment,
W83-04095 5B

The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

CONFINED AQUIFERS
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

CONFINED-WATER WELLS
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

CONNECTICUT
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

CONSERVATION
Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

CONSTRUCTION METHODS
Experience in the Use of Rolled Concrete,
W83-04169 8F

COOLING WATER
Multiport Diffusers for Heat Disposal: A Summary,
W83-03864 8B

Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

COPPER
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

COPPER SULFATE
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

CORN
Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

CORROSION CONTROL
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

COST-BENEFIT ANALYSIS
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

COST ESTIMATES
Solar Powered Electrodialysis - Part II,
W83-03921 3A

COSTS
Quick Returns Don't Pay in Water and Soil Conservation,
W83-04024 6B

CROP PRODUCTION
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

CROP YIELD
A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

CROP YIELDS
Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

CZECHOSLOVAKIA
Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

DAM CONSTRUCTION
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

Experience in the Use of Rolled Concrete,
W83-04169 8F

DAM DESIGN
Financial Aspects of Dam Safety,
W83-04078 8A

Material for Embankment Dams,
W83-04081 8D

The Use of Geotextiles in French Earth Dams,
W83-04082 8D

Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

Large Capacity Bulb Units in Japan,
W83-04166 8C

DAM FOUNDATIONS
Material for Embankment Dams,
W83-04081 8D

DAM STABILITY
P.I.D. Regulation Revisited,
W83-04080 6B

The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

DAMSITES
Large Capacity Bulb Units in Japan,
W83-04166 8C

DATA ACQUISITION
Measurement of Water Flows in Unsaturated Media,
W83-03948 2G

DATA COLLECTION
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

DATA COLLECTIONS
Glaciers as a Water Resource,
W83-04021 2C

DATA STORAGE AND RETRIEVAL
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

DATA TRANSMISSION
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

DEBRIS FLOW
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

DECISION MAKING
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

DEEP PERCOLATION
Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

DEFICIT IRRIGATION
Economic Optimization of Irrigation,
W83-04007 3F

DEGRADATION
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

DENITRIFICATION
Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

DESALINATION
Biphase Turbine for Reverse Osmosis Desalination,
W83-03910 8C

The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

Desalting Water in Florida,
W83-04196 3A

DESALINATION PLANTS
Solar Powered Electrodialysis - Part II,
W83-03921 3A

DESALINATION PROCESSES
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

DESIGN
Solar Powered Electrodialysis - Part II,
W83-03921 3A

DESIGN CRITERIA
Energy-Efficient Aeration of Activation Basins (Energiefreundliche Beluftung Von Belebungsbecken),
W83-03925 5D

Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

Evaluating Low-Volume Irrigation Systems for Emission Uniformity,
W83-04111 3F

Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

Physical Design of Overland Flow Systems,
W83-04180 5E

DESORPTION
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

DETENTION RESERVOIRS
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

DETERGENTS
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

DETERMINISTIC METHODS
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

DEUTERIUM
Determination of Deuterium Oxide in Water by Reversed-Phase High-Performance Liquid Chromatography,
W83-04190 5A

DEVELOPING COUNTRIES
The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

DEWATERING
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

DIFFUSERS
Multiport Diffusers for Heat Disposal: A Summary,
W83-03864 8B

DIFFUSION COEFFICIENT
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

DISINFECTION
Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

DISPERSION
A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

DISSOLVED ORGANIC CARBON
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

DISSOLVED OXYGEN
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

DISSOLVED SOLIDS. *TOXOCITY
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

DISTRIBUTION PATTERNS
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

DISTRICT OF COLUMBIA
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

DRAINAGE
Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

DRAINAGE EFFECTS
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

DRAINAGE ENGINEERING
Early Developments in Drainage Engineering,
W83-04135 4A

DRAINAGE SYSTEMS
Drainage Requirements of Salt Affected Soils,
W83-03886 4A

DRAINS
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

DRINKING WATER
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

DRINKING WATERS
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

DROUGHT
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

DROUGHT HARDENING
Drought Hardening of Crop Plants,
W83-04150 2I

DROUGHT RESISTANCE
Drought Hardening of Crop Plants,
W83-04150 2I

DROUGHTS
Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

DUNES
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

DYNAMICS
Dynamic Estimates of River Pollution Under Conditions of Regulation of the River and Anthropogenic Runoff,
W83-03937 5B

EARTH DAMS
Material for Embankment Dams,
W83-04081 8D

The Use of Geotextiles in French Earth Dams,
W83-04082 8D

EARTHWORKS
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

EASEMENTS
Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

ECOLOGICAL DISTRIBUTION
Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

ECONOMIC ASPECTS
Quick Returns Don't Pay in Water and Soil Conservation,
W83-04024 6B

P.I.D. Regulation Revisited,
W83-04080 6B

Large Capacity Bulb Units in Japan,
W83-04166 8C

The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

EFFLUENT CHARGES
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

ELECTRICAL EQUIPMENT
Large Capacity Bulb Units in Japan,
W83-04166 8C

ELECTROCHEMICAL SENSORS
Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

ELECTRODES
Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

ELECTRODIALYSIS
Solar Powered Electrodialysis - Part II,
W83-03921 3A

EMBANKMENTS
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

Material for Embankment Dams,
W83-04081 8D

Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

ENERGY
Energy-Efficient Aeration of Activation Basins (Energiefreundliche Beluftung Von Belebungsbecken),
W83-03925 5D

ENERGY BALANCE
Internal Energy Balance and the Richards Equation,
W83-04027 2G

ENGLAND
The Operation, Maintenance and Renovation of Sewerage Systems and Pumping Stations in a Large Municipality,
W83-03929 5D

Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

ENTROPY
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

ENVIRONMENTAL EFFECTS
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

Environmental Corrective Programs at the La Grande Complex (Les Amenagements Correctifs D'Environnement Au Complexe La Grande),
W83-04060 6G

Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

ENVIRONMENTAL IMPACT
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

ENZYMES
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

EROSION
Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

EROSION CONTROL
Sediment Pollution Control in North Carolina,
W83-03860 5G

Computer Aid for Terrace Location,
W83-03957 4D

Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

ESTUARIES
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

EUTHROPHICATION
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

EUTROPHICATION
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

EVAPOTRANSPIRATION
An Observational-Data Based Evapotranspiration Function for General Circulation Models,
W83-04116 2D

Water Conservation With Urban Landscape Plants,
W83-04140 3D

FARM MANAGEMENT
Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

FARM PONDS
Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

FARM WASTES
Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

FARMING
Agricultural Meteorology in China,
W83-03851 2B

Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

FATE OF POLLUTANTS
Dynamic Estimates of River Pollution Under Conditions of Regulation of the River and Anthropogenic Runoff,
W83-03937 5B

Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

1982 Stockholm Conference on Acidification of the Environment,
W83-04095 5B

Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

FECAL COLIFORM
Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

FECAL STREPTOCOCCUS
Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

FEDERAL REPUBLIC OF GERMANY
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

FILTER MEDIA
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

FILTERS
The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

FILTRATION
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Low Energy Filtration Using Buoyant Media,
W83-04149 5D

Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

FINANCING
Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

Financial Aspects of Dam Safety,
W83-04078 8A

FISH
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

FISH MANAGEMENT
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

FISH PARASITES
Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

FISH POPULATIONS
Low pH and the Absence of Fish Species in Naturally Acidic Wisconsin Lakes: Inferences for Cultural Acidification,
W83-04108 5C

FLOOD DISCHARGE
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

FLOOD FORECASTING
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

FLOOD FREQUENCY
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

FLOOD PEAKS
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

FLOODS
Discussion-Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W83-04019 2B

FLORIDA
Desalting Water in Florida,
W83-04196 3A

FLOTATION
Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

FLOW
Flow Processes in the Fissure Network Model (Stromungsvorgange Im Vermaschten Kluftmodell),
W83-04092 2F

FLOW CHARACTERISTICS
Internal Energy Balance and the Richards Equation,
W83-04027 2G

FLOW DENSITY
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

FLOW DISCHARGE
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

FLOW VELOCITY
Johnson Velocity Meter System Proves its Worth,
W83-04076 8B

FLOW VISCOSITY
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

FLUID MECHANICS
Multiport Diffusers for Heat Disposal: A Summary,
W83-03864 8B

FLUVIAL SEDIMENTS
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

FLY ASH
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Phosphate Extraction Using Fly Ash,
W83-03913 5F

FORECASTING
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

FOREST LITTER
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

FOREST MANAGEMENT
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

FOREST WATERSHEDS
Characteristics of Sediment and Organic Carbon Export From Pristine Boreal Forest Watersheds,
W83-04109 2E

FRANCE
Current Status of Water Distribution in France. Organizational/Administrative Aspects of the Problem (Situation Actuelle De La Distribution D'Eau en France. Organisation-Aspects Administraties du Probleme).
W83-03964 5F

Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

FURROW IRRIGATION
Discrete-Time, Cutback Furrow Irrigation,
W83-03958 3F

FURROWS
Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

GEOHYDROLOGY
A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

GEOLOGIC FRACTURES
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

Flow Processes in the Fissure Network Model (Stromungsvorgange Im Vermaschten Kluftmodell),
W83-04092 2F

GEOLOGIC MAPPING
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

GEOMORPHOLOGY
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

GEOPHYSICAL SURVEYS
Evaluation of a Ground Transient Electromagnetic Remote Sensing Method for the Deep Detection and Monitoring of Salt Water Interfaces,
W83-03899 7B

GEORGIA
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

GEOTHERMAL RESOURCES
Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

Clarifying Geothermal Fluids,
W83-04052 5F

GEOTHERMAL STUDIES
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

GERMAN DEMOCRATIC REPUBLIC
Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

GLACIAL EVENTS
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

GLACIERS
Glaciers as a Water Resource,
W83-04021 2C

GRAVEL
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

GRAZING
Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

GREAT LAKES
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

GREECE
Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

GROUNDWATER
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

GROUNDWATER AVAILABILITY
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

GROUNDWATER LEVEL
Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

GROUNDWATER MOVEMENT
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

GROUNDWATER POLLUTION
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

GROUNDWATER POTENTIAL
Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

GROUNDWATER PROTECTION
EPA's New Land Disposal Rules-A Closer Look,
W83-04100 5E

GROUNDWATER RECHARGE
Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

GULF OF MAINE
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

HAEMATOCOCCUS
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

HALOGENS
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

HAWAII
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

HEALTH RISKS
Health Risks Associated With Water Recycling,
W83-03971 3C

HEAT EXCHANGERS
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

HEAVY METALS
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

Concentration of Heavy Metals in Seawater and Sediments from the Northern Aegean Sea, Greece,
W83-04056 5B

Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

HUMAN DISEASES

Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

HYDRAULIC CONDUCTIVITY

Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

HYDRAULIC EQUIPMENT

Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

HYDRAULIC GATES

Water Control by Automatic Gates,
W83-04079 8C

HYDRAULIC PROPERTIES

The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

HYDRAULIC TURBINES

Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

HYDROCARBONS

A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

HYDROELECTRIC PLANTS

P.I.D. Regulation Revisited,
W83-04080 6B

Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

HYDROELECTRIC POWER

Large Capacity Bulb Units in Japan,
W83-04166 8C

Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

HYDROGEN ION CONCENTRATION

Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

HYDROGEN PEROXIDE

Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

HYDROLOGIC BUDGET

Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

HYDROLOGIC MAPS

A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

HYDROLOGIC MODELING

A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

HYDROLOGIC MODELS

Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

HYDROTHERMAL STUDIES

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

HYGROMETER

An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

ICE

Glaciers as a Water Resource,
W83-04021 2C

ICE COVER

Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

IDAHO

Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

ILLINOIS

Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

IMPAIRED WATER USE

Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

IMPERVIOUS MEMBRANES

Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

INDIA

Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

Drainage Requirements of Salt Affected Soils,
W83-03886 4A

Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

INDIANA
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

INDICATORS
Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

INDONESIA
Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

INDUSTRIAL WASTEWATER
The Jet Nozzle--A New Submerged Aerator (Die Strahldse--Ein Neuer Tauchbelufter).
W83-03926 5D

Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

INFILTRATION
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

INFRARED IMAGERY
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

INLAND WATERWAYS
Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

INORGANIC CHEMICALS INDUSTRY
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

INSITUFORM
A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

INSPECTION
The Operation, Maintenance and Renovation of Sewerage Systems and Pumping Stations in a Large Municipality,
W83-03929 5D

INSTITUTIONAL CONSTRAINTS
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

INSTREAM FLOW
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

INVERTEBRATES
Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

IODOMETRIC TITRATION
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

ION EXCHANGE
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

IONS
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

IOWA
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

IRON
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

IRON BACTERIA
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

IRRADIATION
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

IRRIGATION
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

Discussion: Optimization of Water Resources for Irrigation in East Jordan, by Janusz R. Rydzewski and Hani A-H. Rashid,
W83-03936 3F

Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

IRRIGATION CANALS
Water Control by Automatic Gates,
W83-04079 8C

IRRIGATION DESIGN
Economic Optimization of Irrigation,
W83-04007 3F

IRRIGATION DITCHES
Border Ditch Irrigation in Colorado,
W83-03959 3F

IRRIGATION EFFECTS
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

IRRIGATION EFFICIENCY
Discrete-Time, Cutback Furrow Irrigation,
W83-03958 3F

Border Ditch Irrigation in Colorado,
W83-03959 3F

Economic Optimization of Irrigation,
W83-04007 3F

Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

IRRIGATION PRACTICES
Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

Evaluating Low-Volume Irrigation Systems for Emission Uniformity,
W83-04111 3F

IRRIGATION PROGRAMS
Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

IRRIGATION REQUIREMENTS
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

Economic Optimization of Irrigation,
W83-04007 3F

IRRIGATION SCHEDULING
Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

Economic Optimization of Irrigation,
W83-04007 3F

Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

IRRIGATION WATER
Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

Impact of Saline Water Irrigation on Some Crops and Their Varieties,
W83-03885 3C

Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

ISOHYETS
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

ISOTOPE STUDIES
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

ITALY
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

JAMES BAY TERRITORY
Environmental Corrective Programs at the La Grande Complex (Les Amenagements Correctifs D'Environnement Au Complexe La Grande),
W83-04060 6G

JAPAN
Large Capacity Bulb Units in Japan,
W83-04166 8C

Experience in the Use of Rolled Concrete,
W83-04169 8F

JETS
The Jet Nozzle--A New Submerged Aerator (Die Strahldüse--Ein Neuer Tauchbelufter).
W83-03926 5D

JORDAN
Discussion: Optimization of Water Resources for Irrigation in East Jordan, by Janusz R. Rydzewski and Hani A-H. Rashid,
W83-03936 3F

KANSAS
Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

KANSAS RIVER
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

KAOLINITE
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

KINETICS
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

LAGOONS
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

LAKE MICHIGAN
Soluble Reactive Phosphorus Measurements in Lake Water: Evidence for Molybdate-Enhanced Hydrolysis,
W83-03977 5A

LAKE SEDIMENTS
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

LAKE STAGES
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

LAKES
Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

Total Dissolved Solids as a Predictor of Lake Biomass and Productivity,
W83-04106 5C

Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

LAMELLA SETTLERS
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

LAND APPLICATION
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

Physical Design of Overland Flow Systems,
W83-04180 5E

LAND DISPOSAL
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

LAND USE
Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

LANDFILLS
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

LANDSAT DATA
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

LEACHATE
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

LEACHATES
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

LEACHING
Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

LEAD
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

LEAF LITTER
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

LEGIONELLA
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

LEGIONNAIRE'S DISEASE BACTERIA
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

LEGISLATION
Sediment Pollution Control in North Carolina,
W83-03860 5G

LEGUMES
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

LEVASINT COATING
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

LIGHT INTENSITY
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

LIMITING NUTRIENTS
Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

LITERATURE REVIEW
Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

LOAM
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

LOCAL PRECIPITATION
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

LOGGING
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

LOUISIANA
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

LYSIMETERS
Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

MACROPHYTES
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

MACROPORES
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

MADISON LIMESTONE
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

MAGNESIUM
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

MARGINAL COSTS
Economic Optimization of Irrigation,
W83-04007 3F

MARINE ANIMALS
Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

MARINE ENVIRONMENT
Concentration of Heavy Metals in Seawater and Sediments from the Northern Aegean Sea, Greece,
W83-04056 5B

MARINE SEDIMENTS
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

MARKETING
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

MARKOV PROCESS
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

MARSHES
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

MARYLAND
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

MASSACHUSETTS
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

MATERIALS ENGINEERING
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

MATHEMATICAL EQUATIONS
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

The Mechanism of Raindrop Splash on Soil Surfaces,
W83-04034 2J

MATHEMATICAL MODELS
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

Water Control by Automatic Gates,
W83-04079 8C

Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

MATHEMATICAL STUDIES
Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

MEASURING INSTRUMENTS
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

Measurement of Hydraulic Conductivity of Unsaturated Soils with Thermocouple Psychrometers,
W83-04025 2G

An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

MEMBRANE PROCESSES
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

MERCURY
Mercury Speciation in Water,
W83-04105 5B

Determination of Mercury in Water by Furnace Atomic Absorption Spectrometry After Reduction and Aeration,
W83-04123 5A

Potentiometric Stripping Analysis for Mercury After Preconcentration in a Potassium Permanganate Trap,
W83-04126 5A

METALLOTHIONEIN
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

METALS
Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

METEOROLOGY
Agricultural Meteorology in China,
W83-03851 2B

METHYL MERCURIC CHLORIDE
Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

MICROCOMPUTER
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

MICROORGANISMS
Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

MINE WASTES
Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

Material for Embankment Dams,
W83-04081 8D

Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

MINERAL WATER
Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

MINERALOGY
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

MINERALS
Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

MISSISSIPPI
Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

MODEL STUDIES
The Essence of Mathematical Models of Reservoir Storage,
W83-03852 4A

Effective Use of STOM,
W83-03931 5D

On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

An Observational-Data Based Evapotranspiration Function for General Circulation Models,
W83-04116 2D

Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

MOISTURE AVAILABILITY
The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

MOLLUSKS
The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

MOLYBDENUM
Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

MOLYBDENUM BLUE METHOD
Soluble Reactive Phosphorus Measurements in Lake Water: Evidence for Molybdate-Enhanced Hydrolysis,
W83-03977 5A

MONITORING
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

MOUNTAIN LAKES
Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

MT. ST. HELENS
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

MULCHES
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

MULCHING
Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

MUNICIPAL
Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

MUNICIPAL WASTEWATER
Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

MUNICIPAL WATERSHEDS
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

MUTAGENS
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

MYCORRHIZAE DEVELOPMENT
Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

MYTILUS
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

NEBRASKA
Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

NEVADA
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

Nitrate in Nevada Playas,
W83-03994 5A

Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

NEW BRUNSWICK
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

NEW JERSEY
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

NEW YORK
Reducing the Formation of Trihalomethanes,
W83-03997 5F

Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

NEW YORK BIGHT
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

NEW ZEALAND
Quick Returns Don't Pay in Water and Soil Conservation,
W83-04024 6B

NICKEL
Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

NITRATE
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

NITRATE-NITROGEN MOVEMENT
Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

NITRATES
Nitrate in Nevada Playas,
W83-03994 5A

NITRIFICATION
Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

NITROAROMATICS
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

NITROGEN
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

NITROGEN COMPOUNDS
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

NITROGEN FIXING BACTERIA
Nitrate in Nevada Playas,
W83-03994 5A

NITROGEN REMOVAL
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

NONPOINT POLLUTION SOURCES
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

NORTH CAROLINA
Sediment Pollution Control in North Carolina,
W83-03860 5G

Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

NORTH DAKOTA
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

NOZZLES
The Jet Nozzle--A New Submerged Aerator (Die Strahldüse--Ein Neuer Tauchbelufter).
W83-03926 5D

NUTRIENT REMOVAL
Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

NUTRIENTS
A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

ODOR CONTROL
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

OIL SHALE
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

OIL WASTES
Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

OILY WATER
Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

ONTARIO
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

OPEN CHANNEL FLOW
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

OPTICAL PROPERTIES
Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

OPTIMIZATION
Economic Optimization of Irrigation,
W83-04007 3F

Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

ORCHARDS
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

OREGON
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

ORGANIC CARBON
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

ORGANIC CHLORINE
Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

ORGANIC COMPOUNDS
Extraction of Priority Pollutants From Solids,
W83-03859 5D

Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

ORGANIC MATTER
Characteristics of Sediment and Organic Carbon Export From Pristine Boreal Forest Watersheds,
W83-04109 2E

Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

ORGANIC PHOSPHATE
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

ORGANIC SOLVENTS
Extraction of Priority Pollutants From Solids,
W83-03859 5D

ORGANIC WASTES
Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

ORGANOPHOSPHATE INSECTICIDE
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

ORTHOPHOSPHATES
Phosphate Extraction Using Fly Ash,
W83-03913 5F

OSMOREGULATION
Drought Hardening of Crop Plants,
W83-04150 2I

OVERLAND FLOW
Physical Design of Overland Flow Systems,
W83-04180 5E

OXIDATION DITCHES
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

OXIDATION PROCESS
Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

OXISOLS
Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

OXYGEN REQUIREMENTS
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

OXYGEN TRANSFER
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

OXYGENATION
Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

OZONATION
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

OZONE
Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

PACIFIC NORTHWEST U.S
Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

PARAMETRIC HYDROLOGY
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

PARAOXON
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

PARATHION
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

PARTICULATES
Use of Particle Size Analysis in Drinking Water Preparation (Zum Einsatz Von Partikelgrossenanalysen In Der Trinkwasseraufbereitung),
W83-04091 5A

PATH OF POLLUTANTS
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

PERFORMANCE EVALUATION
Effective Use of STOM,
W83-03931 5D

The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

The Use of Geotextiles in French Earth Dams,
W83-04082 8D

PERMEABILITY COEFFICIENT
Measurement of Hydraulic Conductivity of Unsaturated Soils with Thermocouple Psychrometers,
W83-04025 2G

Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

PESTICIDE TOXICITY
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

PESTICIDES
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

PHENOL
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

PHENOLS
Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

PHILLIPINES
Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

PHOSPHATES
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

Phosphate Extraction Using Fly Ash,
W83-03913 5F

Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

Soluble Reactive Phosphorus Measurements in Lake Water: Evidence for Molybdate-Enhanced Hydrolysis,
W83-03977 5A

Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

PHOSPHORUS
Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

PHOSPHORUS REMOVAL
Phosphate Extraction Using Fly Ash,
W83-03913 5F

PHOTOGRAPHY
Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

PHOTOIONIZATION
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

PHOTOLYSIS
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

PHOTOOXIDATION
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

PHYSICAL PROPERTIES
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

PHYTOPLANKTON
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

Plankton of the Lower River Murray, South Australia,
W83-03892 5C

Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

PHYTOXICITY
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

PIPES
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

PLANT GROWTH
Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

PLANT WATER POTENTIAL
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

PLAYA SEDIMENTS
Nitrate in Nevada Playas,
W83-03994 5A

PLAYAS
Nitrate in Nevada Playas,
W83-03994 5A

PLUMES
Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

POLARITY
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

POLLUTANT IDENTIFICATION
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

Analysis of Chemistry Associated With Ozonolysis of Organic Pollutant Molecules in Water,
W83-04141 5A

Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

Determination of Deuterium Oxide in Water by Reversed-Phase High-Performance Liquid Chromatography,
W83-04190 5A

Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

POLYAMIDE MEMBRANES
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

POLYCHLORINATED BIPHENYLS
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

POLYCYCLIC AROMATIC HYDROCARBONS
Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

POLYMERS
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

PONDS
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

Lining a Pond To Contain Uranium Tailings,
W83-04101 5E

POPULATION DENSITY
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

POPULATION DYNAMICS
Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

POTABLE WATER
From Wastewater to Drinking Water,
W83-04099 5D

POTHOLE LAKES
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

POWERPLANTS
Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

PRECIPITATION
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

PRECIPITATION INTENSITY
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

PRECIPITATION RATE
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

PRECOAT FILTRATION
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

PREDICTING
Discussion-Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W83-04019 2B

PREDICTION
Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

PRETREATMENT
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

PRETREATMENT OF WATER
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

PROBABILISTIC PROCESS
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

PROBABLE MAXIMUM PRECIPITATION
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

PROCESS CONTROL
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

PRODUCTIVITY
Total Dissolved Solids as a Predictor of Lake Biomass and Productivity,
W83-04106 5C

PROJECT PLANNING
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

PUBLIC HEALTH
Health Risks Associated With Water Recycling,
W83-03971 3C

Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

PUBLIC PARTICIPATION
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

PUBLIC WATERS
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

PUMPING
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

PUMPING TESTS
Johnson Velocity Meter System Proves its Worth,
W83-04076 8B

RADAR
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

RADIOACTIVE WASTES
Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

RADIUM
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

RADON
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

RAINBOW TROUT
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

RAINFALL DISTRIBUTION
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

RAINFALL DISTRIBUTUION
Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

RAINFALL INFILTRATION
An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

RAINFALL INTENSITY
The Mechanism of Raindrop Splash on Soil Surfaces,
W83-04034 2J

RAINFALL-RUNOFF RELATIONSHIPS
An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

RAINFALL SIMULATORS
Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

RECREATION
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

RECREATION FACILITIES
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

RECYCLING
Extraction of Priority Pollutants From Solids,
W83-03859 5D

Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

RED ALDER (ALNUS RUBRA)
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

RED RIVER FORMATION
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

REFORESTATION
Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

REGENERATION
Biological Regeneration of Activated Carbon,
W83-04133 5D

REGRESSION ANALYSIS
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

REGULATED FLOW
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

REGULATIONS
Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

EPA's New Land Disposal Rules-A Closer Look,
W83-04100 5E

REHABILITATION
The Operation, Maintenance and Renovation of Sewerage Systems and Pumping Stations in a Large Municipality,
W83-03929 5D

REINJECTION WELLS
Clarifying Geothermal Fluids,
W83-04052 5F

REMOTE SENSING
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

REPAIR
A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

RESEARCH PRIORITIES
Water Recycling - Research Needs,
W83-03965 3C

RESERVOIR STORAGE
The Essence of Mathematical Models of Reservoir Storage,
W83-03852 4A

RESERVOIRS
Environmental Corrective Programs at the La Grande Complex (Les Amenagements Correctifs D'Environnement Au Complexe La Grande),
W83-04060 6G

RESIDUE CHLORINE
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

RESOURCES MANAGEMENT
P.I.D. Regulation Revisited,
W83-04080 6B

RESPIRATION
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

RETENTION BASINS
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

RETURN FLOW
Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

REVEGETATION
Sediment Pollution Control in North Carolina,
W83-03860 5G

Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

REVERSE OSMOSIS
Biphase Turbine for Reverse Osmosis Desalination,
W83-03910 8C

Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

Desalting Water in Florida,
W83-04196 3A

REVIEWS
Water Recycling - Research Needs,
W83-03965 3C

Water Recycling for Domestic and Agricultural Applications: State of the Art,
W83-03969 3C

RICE
Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

RICHARDS EQUATION
Internal Energy Balance and the Richards Equation,
W83-04027 2G

RIPARIAN RIGHTS
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

RISKS
Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

RIVER BASINS
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

RIVERS
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

ROCK FILL
Material for Embankment Dams,
W83-04081 8D

ROTATING BIOLOGICAL CONTACTORS
Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

ROUGHNESS COEFFICIENT
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

RUNOFF
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

RUNOFF FORECASTING
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

RURAL AREAS
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

SAFETY
Financial Aspects of Dam Safety,
W83-04078 8A

P.I.D. Regulation Revisited,
W83-04080 6B

SALAMANDERS
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

SALINE SOILS
Drainage Requirements of Salt Affected Soils,
W83-03886 4A

SALINE WATER
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

Impact of Saline Water Irrigation on Some Crops and Their Varieties,
W83-03885 3C

A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

SALINE WATER BARRIERS
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

SALINE WATER-FRESHWATER INTERFACES
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

SALINITY
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

SALMONELLA
Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

SALT MARSHES
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

SALT TOELRANCE
Impact of Saline Water Irrigation on Some Crops and Their Varieties,
W83-03885 3C

SALT WATER INTERFACES
Evaluation of a Ground Transient Electromagnetic Remote Sensing Method for the Deep Detection and Monitoring of Salt Water Interfaces,
W83-03899 7B

SAMPLE PREPARATION
The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

SAND
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

SAND-BOX MODEL
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

SASKATCHEWAN
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

SATELLITE TECHNOLOGY
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

SATURATED FLOW
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

SATURATED SOILS
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

SCOUR
The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

SEA LEVEL
Optimal Control of the Caspian Sea Level,
W83-03949 4A

SEASONAL VARIATION
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

Plankton of the Lower River Murray, South Australia,
W83-03892 5C

Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

SEASONAL VARIATIONS
Discussion-Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W83-04019 2B

Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

SEAWATER
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

SECONDARY PRODUCTIVITY
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

SEDIMENT CONTROL
Sediment Pollution Control in North Carolina,
W83-03860 5G

SEDIMENT SIZE
A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

SEDIMENT TRANSPORT
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

Characteristics of Sediment and Organic Carbon Export From Pristine Boreal Forest Watersheds,
W83-04109 2E

SEDIMENT YIELD
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

SEDIMENTARY ROCKS
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

SEDIMENTATION
Historic Changes in an Urban Watershed Determined by Pollen and Geochemical Analyses of Lake Sediment,
W83-04110 5C

SEDIMENTS
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

SEEPAGE
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

SEISMIC PROPERTIES
The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

SELENASTRUM
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

SENSITIVITY ANALYSIS
Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

SEPARATION TECHNIQUES
Extraction of Priority Pollutants From Solids,
W83-03859 5D

Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

SEPTIC TANKS
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

SEPTIC WASTEWATER
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

SETTLERS
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

SETTLING TANKS
Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

SETTLING VELOCITY
Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

SEWER SYSTEMS
The Operation, Maintenance and Renovation of Sewerage Systems and Pumping Stations in a Large Municipality,
W83-03929 5D

SEWERS
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

SILT
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

SIMULATION
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

SIMULATION ANALYSIS
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

SLOPES
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

SLUDGE CONDITIONING
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

SLUDGE DIGESTION
Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

SLUDGE DISPOSAL
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

SLUDGE THICKENING
Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

SMALL WATERSHEDS
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

SNOW
Glaciers as a Water Resource,
W83-04021 2C

SNOWMELT
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

SODIUM CARBONATE
A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

SOIL CHARACTERISTICS
Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

SOIL CONSERVATION
Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

SOIL EROSION
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

SOIL FILTERS
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

SOIL GASES
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

SOIL MOISTURE
Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

SOIL MOISTURE AVAILABILITY
Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

SOIL MOISTURE DEFICIENCY
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

SOIL MOISTURE RETENTION
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

SOIL MORPHOLOGY
Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

SOIL PROPERTIES
Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

SOIL TYPES
Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

SOIL WATER
Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

Internal Energy Balance and the Richards Equation,
W83-04027 2G

Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

SOIL-WATER-PLANT RELATIONSHIPS
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

SOIL WATER POTENTIAL
An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

SOIL WATER STORAGE
Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

SOLAR POWER
Solar Powered Electrodialysis - Part II,
W83-03921 3A

SOLID WASTE DISPOSAL
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

SOLUTE TRANSPORT
A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

SOLUTES
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

SORPTION
Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

SOUTH AFRICA
Water Recycling for Domestic and Agricultural Applications: State of the Art,
W83-03969 3C

SOUTH CAROLINA
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

SPATIAL DISTRIBUTION
Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

SPECIATION
Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

Mercury Speciation in Water,
W83-04105 5B

SPECIES COMPOSITION
Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

SPECIES DIVERSITY
Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

SPECTROPHOTOMETRY
Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

SPECTROSCOPY
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

SPIRIT LAKE
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

SPRINKLER IRRIGATION
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

SPRINKLERS
Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

STABILIZATION PONDS
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

STANDARDS
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

STATISTICAL ANALYSIS
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

STATISTICAL MODELS
Optimal Control of the Caspian Sea Level,
W83-03949 4A

STEEL
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

STOCHASTIC METHODS
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

STOCHASTIC PROCESS
Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

STOCHASTIC PROCESSES
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

STORET
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

STORM SEWER RUNOFF
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

STORM SEWERS
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

STORM WATER
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

STORMS
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

STREAM BANKS
Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

STREAMFLOW FORECASTING
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

STREAMFLOW SYNTHESIS
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

STREET RUNOFF SAMPLES
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

STREPTOCOCCUS
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

SUBLETHAL EFFECTS
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

SUBSURFACE DRAINAGE
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

SUBSURFACE FLOW
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

SULFATE
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

SULFIDES
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

SULFUR
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

SUNFLOWERS
Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

SURFACE FLOW
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

SURFACE-GROUNDWATER REACTIONS
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

SURFACE-GROUNDWATER RELATIONS
Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

SURFACE WATER
Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

SURFACTANTS
The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

Single-Drop Tensammetry,
W83-04125 5A

SUSPENDED SEDIMENTS
Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

SUSPENDED SOLIDS
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

Use of Particle Size Analysis in Drinking Water Preparation (Zum Einsatz Von Partikelgrossenanalysen In Der Trinkwasseraufbereitung),
W83-04091 5A

Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

SWEDEN
Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

TAX LAWS
Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

TAXES
Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

TEMPERATURE EFFECTS
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

TEMPORAL DISTRIBUTION
Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

TENNESSEE
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

TERRACING
Computer Aid for Terrace Location,
W83-03957 4D

TERTIARY WASTEWATER TREATMENT
Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

TEXAS
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

Water Conservation With Urban Landscape Plants,
W83-04140 3D

Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

THAILAND
Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

THE NETHERLANDS
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

THERMAL SLUDGE
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

THERMODYNAMICS
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

THIN LAYER CHROMATOGRAPHY
A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

THIOBACILLUS
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

THORIUM
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

TIDAL POWERPLANTS
Large Capacity Bulb Units in Japan,
W83-04166 8C

TILE DRAINAGE
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

Early Developments in Drainage Engineering,
W83-04135 4A

TILE DRAINS
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

TILLAGE SYSTEMS
Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

TOBACCO
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

TOXICITY
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

A Threshold Concept of Environmental Pollutants,
W83-04057 5C

TRACE ELEMENTS
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

TRACE METALS
Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

The Determination of Trace Elements in Natural Waters Using the Stabilized Temperature Platform Furnace,
W83-04118 5A

Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

TRANSITION ZONES
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

TRANSMISSIVITY
Estimation of Aquifer Transmissivities Using Numerical Models,
W83-04157 2F

TREATED WATER
Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

TREMATODES
Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

TRENCHES
Early Developments in Drainage Engineering,
W83-04135 4A

TRICKLE IRRIGATION
Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

TRIHALOMETHANES
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

Reducing the Formation of Trihalomethanes,
W83-03997 5F

Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

TRINIDAD
Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

TRINITROTOLUENE
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

TURBIDITY
Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

TURBINES
Biphase Turbine for Reverse Osmosis Desalination,
W83-03910 8C

Large Capacity Bulb Units in Japan,
W83-04166 8C

ULTRAFILTRATION
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

ULTRAFINE ION EXCHANGE
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

ULTRAVIOLET RADIATION
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

UNCONFINED AQUIFERS
A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

UNITED KINGDOM
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

UNSATURATED FLOW
Measurement of Water Flows in Unsaturated Media,
W83-03948 2G

A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

Internal Energy Balance and the Richards Equation,
W83-04027 2G

UNSTABLE CHANNELS
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

URANIUM
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

URBAN HYDROLOGY
Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

URBAN LANDSCAPES
Water Conservation With Urban Landscape Plants,
W83-04140 3D

URBAN RUNOFF
Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

USSR
Dynamic Estimates of River Pollution Under Conditions of Regulation of the River and Anthropogenic Runoff,
W83-03937 5B

Optimal Control of the Caspian Sea Level,
W83-03949 4A

UTAH
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

VEGETATION EFFECTS
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

VEGETATION ESTABLISHMENT
Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

VIRGINIA
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

VIRUSES
Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

VITOX SYSTEM
Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

VOLATILITY
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

VOLUMETRIC ANALYSIS
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

WASHINGTON
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

WASTE DISPOSAL
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

EPA's New Land Disposal Rules-A Closer Look,
W83-04100 5E

Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

WASTE RECOVERY
Extraction of Priority Pollutants From Solids,
W83-03859 5D

Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

WASTE STORAGE
Lining a Pond To Contain Uranium Tailings,
W83-04101 5E

WASTE WATER TREATMENT
Purification of Faecal Waters Combined with Algal Protein Production (Ochistvane Na Vodi S Fekalen Kharakter, Suchetano S Poluchavane Na Vodoraslov Protein),
W83-04074 5D

Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

WASTEWATER
Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

WASTEWATER DISPOSAL
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

Physical Design of Overland Flow Systems,
W83-04180 5E

WASTEWATER IRRIGATION
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

WASTEWATER MANAGEMENT
Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

WASTEWATER TREATMENT
Extraction of Priority Pollutants From Solids,
W83-03859 5D

Integrated Control of Combined Sewer Regulators,
W83-03862 5G

Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

Energy-Efficient Aeration of Activation Basins (Energiefreundliche Beluftung Von Belebungsbecken),
W83-03925 5D

The Jet Nozzle--A New Submerged Aerator (Die Strahlduse--Ein Neuer Tauchbelufter).
W83-03926 5D

Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

Effective Use of STOM,
W83-03931 5D

Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

Some Aspects of the Present Status of Algae Cultivation and Their Application (Nekotorye Aspekty Sovremennogo Sostoyaniya Kul'Tivirovaniya Vodoroslei I Ikh Primenenie),
W83-04073 5D

Deep Tank Aeration/Flotation, Clarification Adds a New Treatment Dimension,
W83-04085 5D

From Wastewater to Drinking Water,
W83-04099 5D

An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

Low Energy Filtration Using Buoyant Media,
W83-04149 5D

Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

WASTEWATER TREATMENT FACILITIES

Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

WATER

Mercury Speciation in Water,
W83-04105 5B

WATER ALLOCATION

Discussion: Optimization of Water Resources for Irrigation in East Jordan, by Janusz R. Rydzewski and Hani A-H. Rashid,
W83-03936 3F

WATER ANALYSIS

Soluble Reactive Phosphorus Measurements in Lake Water: Evidence for Molybdate-Enhanced Hydrolysis,
W83-03977 5A

Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

Use of Particle Size Analysis in Drinking Water Preparation (Zum Einsatz Von Partikelgrossenanalysen In Der Trinkwasseraufbereitung),
W83-04091 5A

The Determination of Trace Elements in Natural Waters Using the Stabilized Temperature Platform Furnace,
W83-04118 5A

A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

Determination of Mercury in Water by Furnace Atomic Absorption Spectrometry After Reduction and Aeration,
W83-04123 5A

Single-Drop Tensammetry,
W83-04125 5A

Potentiometric Stripping Analysis for Mercury After Preconcentration in a Potassium Permanganate Trap,
W83-04126 5A

Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

WATER CIRCULATION

The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

WATER CONSERVATION

Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

Water Conservation With Urban Landscape Plants,
W83-04140 3D

Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

WATER DEMAND

Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

WATER DISTRIBUTION

Current Status of Water Distribution in France. Organizational/Administrative Aspects of the Problem (Situation Actuelle De La Distribution D'Eau en France. Organisation-Aspects Administraties du Probleme).
W83-03964 5F

WATER HARVESTING

Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

Residual-Wax Soil Treatments for Water Harvesting,
W83-04038 3B

WATER INFILTRATION

Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

WATER LAW

Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

WATER LEVEL FLUCTUATIONS

Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

WATER MANAGEMENT

Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

WATER MEASUREMENT

Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

WATER POLLUTION

Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

WATER POLLUTION CONTROL
Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

The Regional Seas Program: What Fate for UNEP's Crown Jewels.,
W83-04131 5B

WATER POLLUTION EFFECTS
Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

WATER POLLUTION EFFECTS. *AIR POLLUTION
1982 Stockholm Conference on Acidification of the Environment,
W83-04095 5B

WATER POLLUTION PREVENTION
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

WATER POLLUTION SOURCES
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

The Contamination and Protection of Aquifers,
W83-04020 5B

A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

Groundwater Protection - Sufficient Against Threats to Public Water Supply Due to Groundwater Pollution. (Grundwasser-Schutz - Austreichend Angesichts Der Bedrohung Der Offentlichen Wasserversorgung Durch Grundwasserverunreinigungen.),
W83-04093 5B

Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

WATER QUALITY
Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

WATER QUALITY CONTROL
Current Status of Water Distribution in France. Organizational/Administrative Aspects of the Problem (Situation Actuelle De La Distribution D'Eau en France. Organisation-Aspects Administraties du Probleme).
W83-03964 5F

Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

WATER QUALITY STANDARDS
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

WATER REPELLENT SOILS
Residual-Wax Soil Treatments for Water Harvesting,
W83-04038 3B

WATER REUSE
Water Recycling - Research Needs,
W83-03965 3C

Water Recycling for Domestic and Agricultural Applications: State of the Art,
W83-03969 3C

Health Risks Associated With Water Recycling,
W83-03971 3C

Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

From Wastewater to Drinking Water,
W83-04099 5D

Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

WATER SAMPLING
Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

WATER STATUS MEASUREMENT
Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

WATER STORAGE
Drainage Requirements of Salt Affected Soils,
W83-03886 4A

WATER STRESS
Drought Hardening of Crop Plants,
W83-04150 2I

WATER SUPPLY
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

Current Status of Water Distribution in France. Organizational/Administrative Aspects of the Problem (Situation Actuelle De La Distribution D'Eau en France. Organisation-Aspects Administraties du Probleme).
W83-03964 5F

Groundwater Protection - Sufficient Against Threats to Public Water Supply Due to Groundwater Pollution. (Grundwasser-Schutz - Austreichend Angesichts Der Bedrohung Der Offentlichen Wasserversorgung Durch Grundwasserverunreinigungen.),
W83-04093 5B

WATER SURFACE PROFILES
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

WATER TABLE
Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

WATER TABLE FLUCTUATIONS
Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

WATER TABLE PROFILES
Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

WATER TANKS
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

WATER TREATMENT
Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

Reducing the Formation of Trihalomethanes,
W83-03997 5F

Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

Low Energy Filtration Using Buoyant Media,
W83-04149 5D

WATER TREATMENT

Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

WATER TREATMENT (PLANTS)
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

WATER USE
Water Conservation With Urban Landscape Plants,
W83-04140 3D

WATER USE EFFICIENCY
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

WATERSHED MANAGEMENT
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

WATERSHEDS
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

Historic Changes in an Urban Watershed Determined by Pollen and Geochemical Analyses of Lake Sediment,
W83-04110 5C

WAVE TRAINS
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

WEIRS
Water Control by Automatic Gates,
W83-04079 8C

WELL HYDRAULICS
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

WELL YIELD
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

WEST VIRGINIA
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

WHEAT
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

WILDLIFE
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

X-RAY FLUORESCENCE
Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

X-RAY FLUROESCENCE
Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

ZOOPLANKTON
Plankton of the Lower River Murray, South Australia,
W83-03892 5C

Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

AUTHOR INDEX

ABROL, I. P.
Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

ACHARYA, C. L.
Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

ADAMS, P. W.
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

ADAMS, V. D.
Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

ADRIAN, D. D.
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

AGGARWAL, R. K.
Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

AGGAZZOTTI, G.
Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

AHUJA, L. R.
Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

AL-DURRAH, M. M.
The Mechanism of Raindrop Splash on Soil Surfaces,
W83-04034 2J

AL-HAJJAR, B.
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

ALBERT, D. B.
Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

AMIRFATHI, P.
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

ANDRUZZI, R.
Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

AOKI, T.
Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

ARAL, M. M.
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

ARBER, R. P.
From Wastewater to Drinking Water,
W83-04099 5D

ARCHER, D. R.
Discussion-Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W83-04019 2B

AREN, K.
Potentiometric Stripping Analysis for Mercury After Preconcentration in a Potassium Permanganate Trap,
W83-04126 5A

ARNOLD, K. -H.
Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

ARVIN, E.
Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

ASRAR, G.
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

ATEV, A. P.
Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

ATSUYA, I.
Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

AZIZ EL SAYED, J. A.
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

AZNAREZ, J.
Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

BAES, C. F. III
A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

BAILEY, W. F.
Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

BAKER, M. D.
Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

BALDWIN, R. D.
Lining a Pond To Contain Uranium Tailings,
W83-04101 5E

BALLINGER, D.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

BARAZE, A.
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

BARFIELD, B. J.
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

BARTAK, D. E.
Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

BEG, S. A.
Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

BEIM, A. M.
Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

BEKOV, G. I.
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

BELL, A.
Quick Returns Don't Pay in Water and Soil Conservation,
W83-04024 6B

BELL, C. R.
Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

BELMANS, C. F. M.
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

BENDER, R. L.
Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

BENDERLIEV, K. M.
Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

Purification of Faecal Waters Combined with Algal Protein Production (Ochistvane Na Vodi S Fekalen Kharakter, Suchetano S Poluchavane Na Vodoraslov Protein),
W83-04074 5D

BENHAM, E. C.
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

BERAR, U.
Water Control by Automatic Gates,
W83-04079 8C

BERG, G. E.
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

BEVERIDGE, A.
The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

BEYER, W. N.
Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

BHARGAVA, T. N.
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

BHATI, O. P.
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

BHATIA, K. S.
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

BHUSHAN, L. S.
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

BIERE, A. W.
Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

BINGHAM, R. H.
Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

BISHOP, A. B.
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

BISOGNI, C. A.
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

BLACHFORD, A. J.
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

BLOCK, R. M.
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

BODINE, S. M.
Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

BOEGLY, W. J. JR.
Coal Conversion Solid Waste Disposal,
W83-03858 5E

BOLTON, E. E.
Biological Regeneration of Activated Carbon,
W83-04133 5D

BONILLA, A.
Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

BONOMO, J. D.
Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

BOOKTER, T. J.
Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

BOSSHART, R. P.
Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

BOUMA, J.
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

BOURBIGOT, M. M.
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

BOWIE, A. J.
Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

BRADFORD, J. M.
The Mechanism of Raindrop Splash on Soil Surfaces,
W83-04034 2J

BRAHMA, S. K.
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

BRAKENSIEK, D. L.
An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

BRAUN, H. E.
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

BRAUN, P.
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

BREZONIK, P.
Low Energy Filtration Using Buoyant Media,
W83-04149 5D

BRITT, H. K.
Sediment Pollution Control in North Carolina,
W83-03860 5G

BRITZ, D.
Single-Drop Tensammetry,
W83-04125 5A

BROADBENT, F. E.
Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

BROWN, D. L.
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

BROWN, G.
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

BRUCE, L. P.
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

BRUCE, R. R.
Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

BRUNET, R.
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

BRUNINI, O.
An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

BRYCE, R. W.
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

BUCHAN, L.
The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

BUCHHEIM, M. A.
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

BUDAGOVSKII, A. I.
Measurement of Water Flows in Unsaturated Media,
W83-03948 2G

BUNN, R. A.
Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

BURINI, G.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

BURRELL, B.
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

BURTON, D. T.
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

CALCROFT, M.
Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

CAMERON, D. R.
Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

CAMPANA, M. E.
Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

CARAVAJAL, G. S.
Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

CARLSON, C. -G. H.
Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

CARMICHAEL, W. F.
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

CARRINGTON, E. G.
Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

CARTIER, P. G.
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

CARTWRIGHT, K.
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

CHAMBERS, R. H.
Effective Use of STOM,
W83-03931 5D

CHAMP, M. A.
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

CHANEY, R. L.
Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

CHATTERJI, P. C.
A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

CHEGWIDDEN, A.
Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

CHENG, T. C.
Mercury Speciation in Water,
W83-04105 5B

CHERKESOV, N. V.
Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

CHERY, D. C.
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

CHESHIRE, H. M.
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

CHESTERS, G.
Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

CHIESA, S.
Low Energy Filtration Using Buoyant Media,
W83-04149 5D

CHONG, S. K.
Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

CHOUDHARI, J. S.
Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

CHU, S. -Y.
Internal Energy Balance and the Richards Equation,
W83-04027 2G

CHUNG, S. -O.
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

CLARK, M. J. R.
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

CLINE, D. M.
An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

CLYMA, W.
Border Ditch Irrigation in Colorado,
W83-03959 3F

COLLINS, R. A.
Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

COLLINS, W. J.
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

CONFER, J. L.
Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

CONN, G.
Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

CONTI, R.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

COOPER, J. J.
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

COOTE, D. R.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

CORNEL, P.
Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

COWART, J. B.
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

COX, W. E.
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

CRONIN, L. E.
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

CROOK, B. V.
Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

CROWTHER, H. G.
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

CUDBY, D. B.
Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

CULLEY, J. L. B.
Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

CUNNINGHAM, A. B.
Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

CURTIS, A. A.
Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

CURTIS, R. E. JR.
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

CUSHING, E. M.
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

D'AURIA, J. M.
Historic Changes in an Urban Watershed Determined by Pollen and Geochemical Analyses of Lake Sediment,
W83-04110 5C

DAGUE, R. R.
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

DAHLSTROM, D. A.
Clarifying Geothermal Fluids,
W83-04052 5F

DALENBERG, J. W.
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

DAMIANI, P.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

DANIEL, D. E.
Measurement of Hydraulic Conductivity of Unsaturated Soils with Thermocouple Psychrometers,
W83-04025 2G

DANIELSON, R. E.
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

DAULAY, H. S.
Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

DAVAR, K. S.
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

DAVENPORT, D. C.
Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

DAVIS, C.
Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

DAVIS, E. C.
Coal Conversion Solid Waste Disposal,
W83-03858 5E

DAVIS, J. M.
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

DE DATTA, S. K.
Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

DE JONG, E.
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

DE SOUSA, F.
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

DEKKER, L. W.
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

DELEON, A. A.
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

DEROOS, H. P.
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

DESSY, R. E.
Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

DEWALT, B. R.
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

DEY, R.
Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

DHAR, O. N.
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

DICKINSON, W. T.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

DILOV, C. V.
Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

Purification of Faecal Waters Combined with Algal Protein Production (Ochistvane Na Vodi S Fekalen Kharakter, Suchetano S Poluchavane Na Vodoraslov Protein),
W83-04074 5D

Some Aspects of the Present Status of Algae Cultivation and Their Application (Nekotorye Aspekty Sovremennogo Sostoyaniya Kul'Tivirovaniya Vodoroslei I Ikh Primenenie),
W83-04073 5D

DIPPEL, G.
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

DISSANAYAKE, M. G.
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

DIYAMANDOGLU, V.
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

DOBBERKAU, H. -J.
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

DOE, P. W.
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

DONER, H. E.
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

DONOVAN, T.
Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

DORE, M.
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

DOWNING, A. L.
Water Recycling - Research Needs,
W83-03965 3C

DYKES, G. M.
Desalting Water in Florida,
W83-04196 3A

EDDE, H.
Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

EDEN, G. E.
Water Recycling - Research Needs,
W83-03965 3C

EDENBORN, H. M.
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

EDER, B. K.
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

EISENREICH, S. J.
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

EL'PINER, L. I.
Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

ELLIOTT, N. G.
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

ELNER, J. K.
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

EMERY, W. J.
Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

EMMETT, R. C. JR.
Clarifying Geothermal Fluids,
W83-04052 5F

ENGBERG, R. A.
A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

ENGLISH, M. J.
Economic Optimization of Irrigation,
W83-04007 3F

ERMAN, D. C.
Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

EVANS, B. W.
Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

EVANS, R. D.
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

FAAS, L.
An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

FAHLBUSCH, F.
Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

FAIRBANKS, R. G.
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

FAKHRAEI, H.
Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

FAYER, M. J.
Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

FAYOUX, D.
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

FENNESSY, M. J.
An Observational-Data Based Evapotranspiration Function for General Circulation Models,
W83-04116 2D

FETTIG, J.
Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

FINE, L. O.
Phosphate Extraction Using Fly Ash,
W83-03913 5F

FINK, D. H.
Residual-Wax Soil Treatments for Water Harvesting,
W83-04038 3B

FISHER, J. B.
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

FISHER, S. G.
Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

FITZNER, R. E.
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

FLEISCHACKER, S. J.
Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

FORD, H. W.
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

FOSS, J. E.
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

FOSTER, G. R.
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

FOX, C. A.
Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

FRANCIS, C. W.
Coal Conversion Solid Waste Disposal,
W83-03858 5E

FRANCIS, D. D.
Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

FRANK, R.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

FRANKLIN, M.
Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

FRIBERG, S.
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

FRITH, J. G.
Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

FUJIOKA, R. S.
Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

FULLERTON, H. H.
Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

FYTIANOS, K.
Concentration of Heavy Metals in Seawater and Sediments from the Northern Aegean Sea, Greece,
W83-04056 5B

Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

GANAPATI, P. N.
Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

GANF, G.
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

GARDNER, E. H.
Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

GAY, M. C.
Evaluation of a Ground Transient Electromagnetic Remote Sensing Method for the Deep Detection and Monitoring of Salt Water Interfaces,
W83-03899 7B

GEE, H. K.
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

GENSLER, W.
Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

GERBA, C. P.
Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

GERRITSE, R. G.
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

GHANE, H.
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

GHOSH, P. K.
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

GIDDINGS, J. M.
Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

GILKESON, R. H.
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

GIORDANO, C.
Water Conservation With Urban Landscape Plants,
W83-04140 3D

GLATER, J.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

GLEBOV, V. D.
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

GNAUCK, A. H.
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

GODFREY, P. J.
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

GOFORTH, D.
Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

GOPAL, R.
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

GORDIN, I. V.
Dynamic Estimates of River Pollution Under Conditions of Regulation of the River and Anthropogenic Runoff,
W83-03937 5B

GOULTER, I. C.
Discussion: Optimization of Water Resources for Irrigation in East Jordan, by Janusz R. Rydzewski and Hani A-H. Rashid,
W83-03936 3F

GRACIA, I.
Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

GRADY, C. P. L. JR.
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

GRAHAM, L.
Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

GRANELI, A.
Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

GRANT, S. A.
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

GREEN, R. E.
Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head

GREEN, R. E.

From Measurements of Soil Water Redistribution,
W83-04041 2G

GREGOR, K. -H.
Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

GREGORY, J. M.
Computer Aid for Terrace Location,
W83-03957 4D

GRIFFITHS, J. A.
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

GRIMM, N. B.
Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

GRIMMEISEN, W.
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

GRIMMEL, W.
Energy-Efficient Aeration of Activation Basins (Energiefreundliche Beluftung Von Belebungsbecken),
W83-03925 5D

GROENEWOLD, G. H.
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

GUMBS, F. A.
Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

GUPTA, J. P.
Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

GUSEV, E. M.
Measurement of Water Flows in Unsaturated Media,
W83-03948 2G

HACKES, B. L.
Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

HAGAN, R. M.
Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

HAGEMAN, L.
Determination of Mercury in Water by Furnace Atomic Absorption Spectrometry After Reduction and Aeration,
W83-04123 5A

HAM, R. K.
Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

HAMPTON, B. B.
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

HANDLEY, D.
Evaluating Low-Volume Irrigation Systems for Emission Uniformity,
W83-04111 3F

HANDLEY, J.
Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

HANG, A. N.
Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

HANKS, R. J.
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

HANSON, C. L.
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

HANSON, L. D.
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

HANSON, W. C.
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

HARDEN, D. R.
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

HARGRAVES, P. E.
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

HARKIN, J. M.
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

HARMAN, S. A.
Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

HARROLD, D. E.
Extraction of Priority Pollutants From Solids,
W83-03859 5D

HART, M. A.
Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

HARWARD, M. E.
Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

HASSAN, M. M.
Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

HATCH, G. L.
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

HAYES, J. C.
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

HEGEMANN, D. A.
Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

HEINKE, G. W.
Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

HELM, W. T.
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

HERGENRADER, G. L.
Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

HILEMAN, B.
1982 Stockholm Conference on Acidification of the Environment,
W83-04095 5B

HILLEL, D.
A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

HILLIS, P. A.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

HILTON, J.
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

HIPP, B. W.
Water Conservation With Urban Landscape Plants,
W83-04140 3D

HIROSE, T.
Experience in the Use of Rolled Concrete,
W83-04169 8F

HOLDER-FRANKLIN, M. A.
Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

HOLDRINET, M. V. H.
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

HOLT, C.
Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

HOLTZMAN, R. B.
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

HORING, H.
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schad-

stoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

HORVATH, D. J.
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

HOSSNER, L. R.
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

HOTES, F. L.
Financial Aspects of Dam Safety,
W83-04078 8A

HOUIS, J.
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

HOWARD, W. F. JR.
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

HOWELLS, D. H.
Sediment Pollution Control in North Carolina,
W83-03860 5G

HU, A.
Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

HUCKINS, L. N.
Nitrate in Nevada Playas,
W83-03994 5A

HUGHES, T. C.
Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

HUKKERI, S. B.
Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

HULM, P.
The Regional Seas Program: What Fate for UNEP's Crown Jewels.,
W83-04131 5B

HUNDAL, S. S.
Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

ILIAS, S.
Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

INGRAHAM, N. L.
Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

INMAN, J. C.
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

INNISS, W. E.
Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

IRWIN, R. W.
Early Developments in Drainage Engineering,
W83-04135 4A

ITO, K.
Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

IZUNO, F. T.
Border Ditch Irrigation in Colorado,
W83-03959 3F

JACKSON, E. B.
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

JACKSON, R. E.
The Contamination and Protection of Aquifers,
W83-04020 5B

JACOBSON, R. L.
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

Nitrate in Nevada Playas,
W83-03994 5A

JAGNER, D.
Potentiometric Stripping Analysis for Mercury After Preconcentration in a Potassium Permanganate Trap,
W83-04126 5A

JAIN, T. C.
Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

JAMISON, A.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

JANOVY, J. JR.
Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

JAY, F. M. S.
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

JEFFRIES, C.
Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

JEKEL, M. R.
Use of Particle Size Analysis in Drinking Water Preparation (Zum Einsatz Von Partikelgrossenanalysen In Der Trinkwasseraufbereitung),
W83-04091 5A

JENSEN, W. P.
Phosphate Extraction Using Fly Ash,
W83-03913 5F

JEPPSON, R. W.
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

JINNO, K.
Determination of Deuterium Oxide in Water by Reversed-Phase High-Performance Liquid Chromatography,
W83-04190 5A

JIRKA, G. H.
Multiport Diffusers for Heat Disposal: A Summary,
W83-03864 8B

JOHNSON, A. H.
Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

JOHNSON, M. L.
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

JOHNSON, R. C.
The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

JOHNSTON, D. W.
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

JOHNSTONE, D. W. M.
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

JONES, E. R.
Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

JONES, J. G.
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

JONES, M.
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

JOO-HWA TAY, A.
Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

JOSHI, D. C.
Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

JURY, W. A.
Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

KAARET, T.
Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

KACHANOSKI, R. G.
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

KALLA, A. K.
Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

KANEMASU, E. T.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

KANEMASU, E. T.

Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

KARLINGER, M. R.
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

KEEFER, G. B.
Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

KEEFER, R. F.
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

KEENAN, J. D.
Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

KELLER, D. M.
Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

KELLY, M. G.
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

KELSEY, H. M.
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

KEMSLEY, S.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

KEUNE, H.
Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

KHERA, K. L.
Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

KHORRAM, S.
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

KIEFER, B.
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

KIM, D. -C.
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

KLEI, H. E.
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

KLEMES, V.
The Essence of Mathematical Models of Reservoir Storage,
W83-03852 4A

KLOKE, A.
Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

KNOX, K.
Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

KOCH, R.
Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

A Threshold Concept of Environmental Pollutants,
W83-04057 5C

KRASOVSKII, G. N.
Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

KRINGSTAD, K. P.
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

KRISTENSEN, G. H.
Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

KROLL, D. G.
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

KROSZYNSKI, U. I.
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

KUENZLER, E. J.
Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

KUMMLER, R. H.
Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

KUNZE, R. J.
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

KURTH, G.
An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

KUSHNER, D. J.
Mercury Speciation in Water,
W83-04105 5B

KUZNETSOV, V. S.
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

LAIRD, D.
Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

LAL, B.
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

LAL, F.
A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

LAL, M.
Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

LAL, P.
A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

LANCE, J. C.
Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

LAND, L. F.
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

LANDSBERGER, S.
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

LARSON, D. C.
Johnson Velocity Meter System Proves its Worth,
W83-04076 8B

LARSON, D. T.
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

LASCANO, R. J.
Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

LASENBY, D. C.
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

LAU, L. S.
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

LAVY, T. L.
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

LEATHAM, S.
Nitrate in Nevada Playas,
W83-03994 5A

LEBOFF, J. P.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

LECOMTE, R.
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

LEDERER, D. O.
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

LEE, E. S.
Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

LEE-STADELMANN, O.
Drought Hardening of Crop Plants,
W83-04150 2I

LEGUBE, B.
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

LELAND, D. F.
A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

LEMLEY, A. T.
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

LEMMER, H. R.
Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

LEPELE, M. J.
Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

LETOKHOV, V. S.
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

LEWIS, D. T.
Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

LEYDEN, D. E.
Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

LIANG, C. -S.
Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

LICK, W.
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

LIGON, J. T.
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

LILLEVIK, S. L.
Discrete-Time, Cutback Furrow Irrigation,
W83-03958 3F

LIMBURG, P. L.
Biphase Turbine for Reverse Osmosis Desalination,
W83-03910 8C

LINDAU, C. W.
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

LINDSAY, J. I.
Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

LINES, G. C.
Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

LINVILL, D. F.
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

LIU, C. C. K.
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

LJUNGQUIST, P. O.
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

LLOYD, A.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

LOTH, P.
The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

LOUDIERE, D.
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

LUNDSTROM, J. E.
Solar Powered Electrodialysis - Part II,
W83-03921 3A

LYNCH, J. D.
Solar Powered Electrodialysis - Part II,
W83-03921 3A

MAASE, D. L.
Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

MABEY, W. R.
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

MACCARY, L. M.
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

MACDONALD, E. M.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

MAGNUSON, J. J.
Low pH and the Absence of Fish Species in Naturally Acidic Wisconsin Lakes: Inferences for Cultural Acidification,
W83-04108 5C

MAHAN, K. I.
Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

MAHONEY, D.
Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

MALI, G. C.
A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

MALIWAL, G. L.
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

MANNERING, J. V.
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

MANNING, D. C.
The Determination of Trace Elements in Natural Waters Using the Stabilized Temperature Platform Furnace,
W83-04118 5A

MARCHANT, R.
Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

MARKISH, M. S.
Optimal Control of the Caspian Sea Level,
W83-03949 4A

MARROSU, G.
Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

MATHESON, A. T.
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

MATHEWES, R. W.
Historic Changes in an Urban Watershed Determined by Pollen and Geochemical Analyses of Lake Sediment,
W83-04110 5C

MAYFIELD, C. I.
Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

MCCARTER, J. A.
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

MCCARTHY, G. J.
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

MCCRAY, S.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

MCCUTCHAN, J. W.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

MCDANIEL, J.
Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

MCGARVEY, F. X.
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

MCINTOSH, M. S.
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

MCKEAGUE, J. A.
Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

MCKEE, M.
Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

MCPHERSON, M. B.
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

MCTIGHE, T. C.
Reducing the Formation of Trihalomethanes,
W83-03997 5F

MEEK, B.
Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

MEIER, M. F.
Glaciers as a Water Resource,
W83-04021 2C

MELACK, J. M.
Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

MELMED, L. N.
Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

MERKEL, B.
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

MESSER, J. J.
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

MEYER, L. D.
A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

MIFFLIN, M. D.
Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

MILL, T.
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

MILLER, D. E.
Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

MILLER, E.
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

MINEAR, R. A.
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

MING-TANG, Y.
Low Energy Filtration Using Buoyant Media,
W83-04149 5D

MIRANOWSKI, J. A.
Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

MITCHELL, J. K.
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

MIYAKAWA, S.
Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

MOESLUND, B.
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

MOK, B. S.
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

MOLDENHAUER, W. C.
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

MOLNAU, M.
Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

MONARO, S.
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

MOORE, R. W. JR.
Clarifying Geothermal Fluids,
W83-04052 5F

MORGAN, K. M.
Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

MORRIS, R. P.
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

MORRISH, A.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

MORRISON, A.
EPA's New Land Disposal Rules-A Closer Look,
W83-04100 5E

MORRISON, S. D.
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

MORROW, C. M.
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

MOTOMIZU, S.
Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

MRKVA, M.
Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

MULHERN, B. M.
Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

MUNEMORI, M.
Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

MUNGER, J. W.
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

NAIMAN, R. J.
Characteristics of Sediment and Organic Carbon Export From Pristine Boreal Forest Watersheds,
W83-04109 2E

NAKAMURA, B. C.
Economic Optimization of Irrigation,
W83-04007 3F

NALEPA, R.
Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

NARAYANA, D. V. V.
Drainage Requirements of Salt Affected Soils,
W83-03886 4A

NARAYANAN, R.
Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

NEELY, W. C.
Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

NEILSEN, G. H.
Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

NELSON, A. G.
Economic Optimization of Irrigation,
W83-04007 3F

NELSON, P. O.
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

NELSON, W. H.
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

NEMETH, G.
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

NEUMAN, S. P.
Estimation of Aquifer Transmissivities Using Numerical Models,
W83-04157 2F

NEWMAN, K. W.
Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

NEWTON, J. G.
Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

NIELSEN, K. C.
Economic Optimization of Irrigation,
W83-04007 3F

NNAJI, S.
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

NOBE, K.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

NOSS, R. R.
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

NUSS, G. S.
Economic Optimization of Irrigation,
W83-04007 3F

O'CONNOR, W. P.
Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

OEY, H. S.
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

OLAFSON, R. W.
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

OLIVO, R.
Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

OLSON, R. V.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

OSSEYRANE, M.
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

OSTENDORF, D. W.
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

OSTERKAMP, W. R.
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

OSTRY, R. C.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

OTOMO, M.
Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

OWENS, R.
A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

PADHIYAR, B. P.
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

PAETH, R. C.
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

PARADIS, P.
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

PAREEK, O. P.
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

PARKS, S. W.
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

PARR, A. D.
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

PASQUINI, R.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

PATEL, P. T.
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

PATRIZI, K. S.
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

PEARLMUTTER, N. L.
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

PEARSON, F. H.
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

PENMAN, A. D. M.
Material for Embankment Dams,
W83-04081 8D

PERFETTI, J.
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

PERROUX, K. M.
Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

PETERKA, J. J.
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

PETERSON, D. L.
Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

PETTY, R. L.
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

PICKERING, N.
Evaluating Low-Volume Irrigation Systems for Emission Uniformity,
W83-04111 3F

PICKERING, W. F.
The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

PIKE, E. B.
Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

PODMORE, T. H.
Border Ditch Irrigation in Colorado,
W83-03959 3F

POLPRASERT, C.
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

POTGIETER, D. J. J.
Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

POWERS, W. L.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

PRASAD, S. N.
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

PRASADA RAO, G. S. L. H. V.
Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

PREDIERI, G.
Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some

PREDIERI, G.
Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

PREPAS, E. E.
Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

Total Dissolved Solids as a Predictor of Lake Biomass and Productivity,
W83-04106 5C

PRICE, D. R.
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

PRINGLE, W. C.
Analysis of Chemistry Associated With Ozonolysis of Organic Pollutant Molecules in Water,
W83-04141 5A

PRUITT, W. O.
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

PUENTE, C.
Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

PUKITE, A.
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

RAATS, P. A. C.
Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

RADAYEV, V. N.
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

RAHEL, F. J.
Low pH and the Absence of Fish Species in Naturally Acidic Wisconsin Lakes: Inferences for Cultural Acidification,
W83-04108 5C

RAI, L. C.
Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

RAI, M.
Impact of Saline Water Irrigation on Some Crops and Their Varieties,
W83-03885 3C

RAKHECHA, P. R.
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

RAMAMOORTHY, S.
Mercury Speciation in Water,
W83-04105 5B

RAMAN, A. V.
Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

RANDOLPH, J.
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

RANDTKE, S. J.
Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

RANSFORD, G. D.
P.I.D. Regulation Revisited,
W83-04080 6B

RAO, A. R.
Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

RAWLS, W. J.
An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

REARDON, J. C.
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

RENWICK, W. H.
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

RHOTON, F. E.
A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

RICHARDSON, L. B.
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

RICKARD, W. H.
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

RILEY, G. A.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

RIPLEY, B. D.
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

RISSMANN, E. F.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

RITTMANN, B. E.
Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

RITZ, D. A.
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

ROBBINS, J. W. D.
Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

ROBBINS, K. D.
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

ROBERTS, M. H.
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

ROBINSON, J. W.
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

ROBINSON, P. J.
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

ROCH, M.
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

ROGERS, D.
Deep Tank Aeration/Flotation, Clarification Adds a New Treatment Dimension,
W83-04085 5D

ROHMANN, U.
Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

ROJIANI, K. B.
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

ROLFE, G. L.
Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

ROLSTON, D. E.
Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

ROMERO, B. R.
Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

RONAYNE, M. P.
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

ROOTS, E. F.
Glaciers as a Water Resource,
W83-04021 2C

ROSENBERG, N. J.
Agricultural Meteorology in China,
W83-03851 2B

ROSS, B. B.
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

ROSS, J. D.
Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

ROWE, R. R.
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

ROYER, L.
Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

RUNDLE, H.
Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

SACK, W. A.
Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

SALANITRO, J. P.
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

SALZWEDEL, J.
Groundwater Protection - Sufficient Against Threats to Public Water Supply Due to Groundwater Pollution. (Grundwasser-Schutz - Austreichend Angesichts Der Bedrohung Der Offentlichen Wasserversorgung Durch Grundwasserverunreinigungen.),
W83-04093 5B

SANDHU, B. S.
Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

SANDHU, S. S.
Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

SANTO, L. T.
Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

SCARBOROUGH, J. N.
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

SCASSELLATI SFORZOLINI, G.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

SCHEPERS, J. S.
Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

SCHIELDS, P. J.
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

SCHROEDER, E. D.
Physical Design of Overland Flow Systems,
W83-04180 5E

SCHROEDER, E. E.
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

SCHROEDER, S. A.
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

SCHUSTER, H.
Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

SCHUTTE, C. F.
Water Recycling for Domestic and Agricultural Applications: State of the Art,
W83-03969 3C

SCHWILLE, F.
Flow Processes in the Fissure Network Model (Stromungsvorgange Im Vermaschten Kluftmodell),
W83-04092 2F

SCOTT, E. C.
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

SCOTT, H. D.
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

SEIDLER, R. J.
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

SELLECK, R. E.
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

SELLEK, J. W.
The Operation, Maintenance and Renovation of Sewerage Systems and Pumping Stations in a Large Municipality,
W83-03929 5D

SEMMENS, M. J.
Low Energy Filtration Using Buoyant Media,
W83-04149 5D

SHACKELFORD, W. M.
An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

SHAH, C. B.
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

SHANHOLTZ, V. O.
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

SHANK, R.
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

SHARMA, K. D.
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

SHARMA, R. C.
Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

SHARMA, V. C.
Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

SHARP, R. D.
A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

SHARPLEY, A. N.
Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

SHEETS, P. J.
Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

SHIEL, R. J.
Plankton of the Lower River Murray, South Australia,
W83-03892 5C

SHIMP, G. F.
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

SHIZUMURA, L.
Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

SHUKLA, N. P.
Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

SHUVAL, H. I.
Health Risks Associated With Water Recycling,
W83-03971 3C

SIEMER, D. D.
Determination of Mercury in Water by Furnace Atomic Absorption Spectrometry After Reduction and Aeration,
W83-04123 5A

SIMPSON, B.
Water Conservation With Urban Landscape Plants,
W83-04140 3D

SIMPSON, E. S.
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

SINGH, B.
Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

SINGH, G.
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

SINGH, H. P.
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

SINGH, I. M.
Reducing the Formation of Trihalomethanes,
W83-03997 5F

SINGH, K. S.
A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

SINGH, R. N.
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

SINGH, R. P.
Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

SINGH, S.
A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

SINGH, V. P.
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

SIPP, S. K.
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

SIRONS, G. J.
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

SLAVIN, W.
The Determination of Trace Elements in Natural Waters Using the Stabilized Temperature Platform Furnace,
W83-04118 5A

SMILES, D. E.
Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

SMITH, R. G.
Physical Design of Overland Flow Systems,
W83-04180 5E

SNIPES, D. S.
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

SOCHA, M. M.
Solar Powered Electrodialysis - Part II,
W83-03921 3A

SONTHEIMER, H.
Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

SOTTON, M.
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

SPACIE, A.
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

SPEARING, B. W.
Effective Use of STOM,
W83-03931 5D

SPOSITO, G.
Internal Energy Balance and the Richards Equation,
W83-04027 2G

SRIVASTAVA, K. K.
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

STADELMANN, E. J.
Drought Hardening of Crop Plants,
W83-04150 2I

STAFFORD, D. B.
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

STAVOLA, A. M.
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

STEPHENS, T. A.
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

STEWART, M. T.
Evaluation of a Ground Transient Electromagnetic Remote Sensing Method for the Deep Detection and Monitoring of Salt Water Interfaces,
W83-03899 7B

STIASSNIE, M.
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

STOLZY, L. H.
Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

STONE, K. L.
Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

STONE, L. R.
Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

STONE, S.
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

STRAUGHAN, I. R.
Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

STROBEL, K.
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

STROMAN, M.
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

STROMBERG, L. M.
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

STURM, T. W.
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

SUBRAMANIAM, A. R.
Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

SUD, Y. C.
An Observational-Data Based Evapotranspiration Function for General Circulation Models,
W83-04116 2D

SUDDUTH, K. A.
Computer Aid for Terrace Location,
W83-03957 4D

SUN, P. T.
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

SUNDSTROM, D. W.
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

SUOZZO, R.
Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

SUTOVSKAYA, I. V.
Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

SVORCOVA, L.
Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

SWAIN, R.
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

SWALLOW, C. W.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

SWANSON, K. D.
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

SWANSON, S. A.
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

SWARTZENDRUBER, D.
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

SWIGERT, J. P.
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

TAK, T. C.
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

TALBOT, V.
Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

TARAPCHAK, S. J.
Soluble Reactive Phosphorus Measurements in Lake Water: Evidence for Molybdate-Enhanced Hydrolysis,
W83-03977 5A

TAYLOR, R. L.
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

TERNERO, M.
Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

TERRY, R. V.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

THANH, N. C.
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

THERRIEN, D.
Environmental Corrective Programs at the La Grande Complex (Les Amenagements Correctifs D'Environnement Au Complexe La Grande),
W83-04060 6G

THOMAS, A. W.
Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

THORNE, M. D.
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

THORNTON, J. B.
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

THURTELL, G. W.
An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

THYSSEN, N.
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

TISON, D. L.
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

TOEI, K.
Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

TOLLNER, E. W.
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

TOPP, G. C.
Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

TOY, D. W.
Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

TRAMONTINI, E. M.
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

TRAZZA, A.
Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

TREW, D. O.
Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

TSAI, C.-F.
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

TSE, D.
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

TSEZOS, M.
Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

TUCOVIC, I. V.
The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

TUNTOOLAVEST, M.
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

TURNER, R. R.
Coal Conversion Solid Waste Disposal,
W83-03858 5E

TWEDELL, A. M.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

UBELL, K.
Flow Processes in the Fissure Network Model (Stromungsvorgange Im Vermaschten Kluftmodell),
W83-04092 2F

UBERTINI, L.
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

UDLUFT, P.
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

UEBLER, R. L.
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

UEDA, T.
Large Capacity Bulb Units in Japan,
W83-04166 8C

UNGER, P. W.
Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

VAN BAVEL, C. H. M.
Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

VAN DEN BROEK, H. H.
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

VAN, H. N. N.
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

VAN VLIET, L. J. P.
Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

VASILIKIOTIS, G.
Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

VASILIKIOTIS, G. S.
Concentration of Heavy Metals in Seawater and Sediments from the Northern Aegean Sea, Greece,
W83-04056 5B

VAUX, H. J. JR.
Evaluating Low-Volume Irrigation Systems for Emission Uniformity,
W83-04111 3F

Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

VENEMAN, P. L. M.
Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

VERMA, C. M.
Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

VIDAL, J. C.
Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

VIGG, S. C.
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

VIVONA, M. A.
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

VOLK, V. V.
Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

VRIESEMA, R.
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

WAKIMOTO, T.
Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

WALKER, K. F.
Plankton of the Lower River Murray, South Australia,
W83-03892 5C

WALKER, P. N.
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

WALL, G. J.
Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

WALLIS, D. A.
Biological Regeneration of Activated Carbon,
W83-04133 5D

WANG, C.
Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

WANG, D. -S.
Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

WARD, T. J.
The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

WARINNER, J. E. JR.
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

WEGMAN, R. C. C.
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

WHALEN, G. A.
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

WHEATCRAFT, S. W.
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

WHISLER, F. D.
A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

WHITE, I.
Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

WIEDENHEFT, W. D.
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

WIEMER, B.
A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

WILDISH, D. J.
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

WILLIAMS, W. D.
Plankton of the Lower River Murray, South Australia,
W83-03892 5C

WILLIAMS, W. T.
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

WILSON, J. D.
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

WILSON, S. A.
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

WISCHNER, R.
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

WITTMUSS, H. D.
Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

WOESTE, F. E.
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

WOLANSKI, E.
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

WOLF, D. C.
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

WONG, P. T. S.
Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

WRIGHT, D.
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

YADAV, R. C.
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

YANG, E.
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

YANG, V.
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

YASUDA, H.
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

YEGOROV, A. S.
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

YOO, K. H.
Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

YOUNG, J. C.
Extraction of Priority Pollutants From Solids,
W83-03859 5D

YOUNG, P. C.
The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

YOUNG, P. W.
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

ZACHARIAH, M.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

ZEGELIN, S. J.
Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

ZIARKOWSKI, S. M.
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

ZOTOU, A.
Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

ORGANIZATIONAL INDEX

AARHUS UNIV. (DENMARK). DEPT. OF CHEMISTRY.
Single-Drop Tensammetry,
W83-04125 5A

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, BENEDICT, MD. BENEDICT ESTUARINE RESEARCH LAB.
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF BOTANY.
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF ZOOLOGY.
Plankton of the Lower River Murray, South Australia,
W83-03892 5C

AGRICULTURAL RESEARCH AND EDUCATION CENTER, LAKE ALFRED, FL.
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD.
An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD. HYDROLOGY LAB.
Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

AGRICULTURAL RESEARCH SERVICE, BOISE, ID. NORTHWEST WATERSHED RESEARCH CENTER.
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

AGRICULTURAL RESEARCH SERVICE, DURANT, OK. WATER QUALITY AND WATERSHED RESEARCH LAB.
Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

AGRICULTURAL RESEARCH SERVICE, LINCOLN, NE.
Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

AGRICULTURAL RESEARCH SERVICE, OXFORD, MS. SEDIMENTATION LAB.
Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

AGRICULTURAL RESEARCH SERVICE, PHOENIX, AZ. WATER CONSERVATION LAB.
Residual-Wax Soil Treatments for Water Harvesting,
W83-04038 3B

AGRICULTURAL RESEARCH SERVICE, SHAFTER, CA. COTTON RESEARCH STATION.
Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

AKADEMIYA NAUK SSSR, MOSCOW. INST. SPEKTROSKOPII.
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

ALBERTA ENVIRONMENTAL CENTER, VEGREVILLE.
Mercury Speciation in Water,
W83-04105 5B

ALBERTA UNIV., EDMONTON. DEPT. OF ZOOLOGY.
Total Dissolved Solids as a Predictor of Lake Biomass and Productivity,
W83-04106 5C

Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

AMERICAN UNIV., WASHINGTON, DC. DEPT. OF BIOLOGY.
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

AMETEK, INC., SHEBOYGAN, WI. PLYMOUTH PRODUCTS DIV.
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

ANDHRA UNIV., WALTAIR (INDIA). DEPT. OF METEOROLOGY AND OCEANOGRAPHY.
Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

ANDHRA UNIV., WALTAIR (INDIA). DEPT. OF ZOOLOGY.
Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

ANGLIAN WATER AUTHORITY, NORWICH (ENGLAND). NORWICH SEWAGE DIV.
Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

ARBER (RICHARD P.) ASSOCIATES, INC., DENVER, CO.
From Wastewater to Drinking Water,
W83-04099 5D

ARIZONA STATE UNIV., TEMPE. DEPT. OF ZOOLOGY.
Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

ARIZONA UNIV., TUCSON. DEPT. OF ELECTRICAL ENGINEERING.
Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
Estimation of Aquifer Transmissivities Using Numerical Models,
W83-04157 2F

ARIZONA WATER RESOURCES RESEARCH CENTER, TUCSON.
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRONOMY.
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF ENVIRONMENTAL ENGINEERING.
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

AUBURN UNIV., AL. DEPT. OF CHEMISTRY.
Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

AUSTRALIAN INST. OF MARINE SCIENCES, TOWNSVILLE.
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA.
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

BAYER A.G., LEVERKUSEN (GERMANY, F.R.).
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

BINNIE AND PARTNERS, LONDON (ENGLAND).
Water Recycling - Research Needs,
W83-03965 3C

Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

BIOLOGISCHE BUNDESANSTALT FUER LAND- UND FORSTWIRTSCHAFT, BERLIN (GERMANY, F.R.). INST. FOR NON-PARASITIC PLANT DISEASES.
Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

BLACK AND VEATCH, DENVER, CO.
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

BONN UNIV. (GERMANY, F.R.). INST. FUER DAS RECHT DER WASSERWIRTSCHAFT.
Groundwater Protection - Sufficient Against Threats to Public Water Supply Due to Groundwater Pollution. (Grundwasser-Schutz - Austreichend Angesichts Der Bedrohung Der Offentlichen Wasserversorgung Durch Grundwasserverunreinigungen.),
W83-04093 5B

BRIDGEPORT HYDRAULIC CO., CT. SYSTEMS OPERATIONS DEPT.
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF OCEANOGRAPHY.
Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

BUNDESANSTALT FUER GEWAESSERKUNDE, COBLENZ (GERMANY, F.R.).
Flow Processes in the Fissure Network Model (Stromungsvorgange Im Vermaschten Kluftmodell),
W83-04092 2F

CALIFORNIA INST. OF TECH., PASADENA. W.M. KECK LAB. OF ENVIRONMENTAL ENGINEERING SCIENCE.
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

CALIFORNIA UNIV., BERKELEY. DEPT. OF FORESTRY AND RESOURCES MANAGEMENT.
Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

CALIFORNIA UNIV., BERKELEY. DEPT. OF PLANT AND SOIL BIOLOGY.
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

CALIFORNIA UNIV., BERKELEY. SCHOOL OF PUBLIC HEALTH.
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

CALIFORNIA UNIV., DAVIS. DEPT. OF AGRICULTURAL ECONOMICS.
Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

CALIFORNIA UNIV., DAVIS. DEPT. OF CIVIL ENGINEERING.
Physical Design of Overland Flow Systems,
W83-04180 5E

CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR AND WATER RESOURCES.
Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF CHEMICAL, NUCLEAR, AND THERMAL ENGINEERING.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

CALIFORNIA UNIV., SANTA BARBARA. MARINE SCIENCE INST.
Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

CASE WESTERN RESERVE UNIV., CLEVELAND, OH. DEPT. OF GEOLOGICAL SCIENCES.
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

CENTRAL ARID ZONE RESEARCH INST., JODHPUR (INDIA).
Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

CENTRAL SOIL AND WATER CONSERVATION RESEARCH AND TRAINING INST., DEHRA DUN (INDIA).
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

CENTRAL SOIL SALINITY RESEARCH INST., KARNAL (INDIA).
Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

Drainage Requirements of Salt Affected Soils,
W83-03886 4A

Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

CHANDRA SHEKAR AZAD UNIV. OF AGRICULTURE AND TECHNOLOGY, KANPUR (INDIA).
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

CHULALONGKORN UNIV., BANGKOK (THAILAND). DEPT. OF SANITARY ENGINEERING.
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

CLEANAWAY LTD., RAYLEIGH (ENGLAND).
Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

CLEMSON UNIV., SC. DEPT. OF CIVIL ENGINEERING.
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

COASTAL AND MARINE ENGINEERING RESEARCH INST., HAIFA (ISRAEL). DEPT. OF CIVIL ENGINEERING.
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND CHEMICAL ENGINEERING.
Border Ditch Irrigation in Colorado,
W83-03959 3F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA).
Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF ENVIRONMENTAL MECHANICS.
Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CRONULLA (AUSTRALIA). DIV. OF FISHERIES RESEARCH.
The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

CONNECTICUT UNIV., STORRS. INST. OF WATER RESOURCES.
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

CORNELL UNIV., ITHACA, NY. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Multiport Diffusers for Heat Disposal: A Summary,
W83-03864 8B

DEFENCE LAB., JODHPUR (INDIA).
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

DEPARTMENT OF AGRICULTURE, GUELPH (ONTARIO). INST. OF PEDOLOGY.
Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

DEPARTMENT OF AGRICULTURE, OTTAWA (ONTARIO). LAND RESOURCE RESEARCH INST.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

DEPARTMENT OF AGRICULTURE, SUMMERLAND (BRITISH COLUMBIA). RESEARCH STATION.
Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

DEPARTMENT OF FISHERIES AND OCEANS, ST. ANDREWS (NEW BRUNSWICK).
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

DISTRICT OF COLUMBIA DEPT. OF ENVIRONMENTAL SERVICES, WASHINGTON. WASTEWATER DIV.
Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

DRESDEN FORSCHUNGSZENTRUM WASSERTECHNIK (GERMAN D.R.).
Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

EDDE (HOWARD), INC., BELLEVUE, WA.
Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

ENGINEERING AND CONSULTING CO., BELGRADE (YUGOSLAVIA). DEPT. OF UNDERGROUND STRUCTURES.
The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

ENVIROCHEM, PERTH (AUSTRALIA).
Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

ENVIRONMENTAL RESEARCH LAB., ATHENS, GA.
An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

ENVIROTECH CORP., SALT LAKE CITY, UT. EIMCO PROCESS MACHINERY DIV.
Clarifying Geothermal Fluids,
W83-04052 5F

EXXON NUCLEAR IDAHO CO., INC., IDAHO FALLS.
Determination of Mercury in Water by Furnace Atomic Absorption Spectrometry After Reduction and Aeration,
W83-04123 5A

FISH AND WILDLIFE SERVICE, LAUREL, MD. PATUXENT WILDLIFE RESEARCH CENTER.
Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

FLORIDA STATE DEPT. OF ENVIRONMENTAL REGULATION, TALLAHASSEE.
Desalting Water in Florida,
W83-04196 3A

FORSCHUNGSINSTITUT FUER MIKROBIOLOGIE UND HYGIENE, BAD ELSTER (GERMAN D.R.).
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

FUJI ELECTRIC CO. LTD., KAWASAKI (JAPAN). HYDRO POWER DIV.
Large Capacity Bulb Units in Japan,
W83-04166 8C

GEOLOGICAL SURVEY, AUSTIN, TX. WATER RESOURCES DIV.
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

GEOLOGICAL SURVEY, LAWRENCE, KS. WATER RESOURCES DIV.
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

GEOLOGICAL SURVEY, LINCOLN, NE. WATER RESOURCES DIV.
A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

GEOLOGICAL SURVEY, MIAMI, FL. WATER RESOURCES DIV.
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

GEOLOGICAL SURVEY, SALT LAKE CITY, UT. WATER RESOURCES DIV.
Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

GEOLOGICAL SURVEY, TUSCALOOSA, AL. WATER RESOURCES DIV.
Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

GEORGIA INST. OF TECH., ATLANTA. DEPT. OF CIVIL ENGINEERING.
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

GEORGIA UNIV., ATHENS. DEPT. OF AGRICULTURAL ENGINEERING.
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

GESELLSCHAFT FUER WIRTSCHAFTSFORDERUNG UND MARKTPLANUNG M.B.H., FRANKFURT AM MAIN (GERMANY, F.R.).
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

GOETEBORG UNIV. (SWEDEN). DEPT. OF ANALYTICAL AND MARINE CHEMISTRY.
Potentiometric Stripping Analysis for Mercury After Preconcentration in a Potassium Permanganate Trap,
W83-04126 5A

GUELPH UNIV. (ONTARIO). DEPT. OF LAND RESOURCE SCIENCE.
An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

GUELPH UNIV. (ONTARIO). SCHOOL OF ENGINEERING.
Early Developments in Drainage Engineering,
W83-04135 4A

GUJARAT AGRICULTURAL UNIV., AHMEDABAD (INDIA).
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

HADASSAH MEDICAL SCHOOL, JERUSALEM (ISRAEL). ENVIRONMENTAL HEALTH LAB.
Health Risks Associated With Water Recycling,
W83-03971 3C

HAWAII UNIV., HONOLULU. WATER RESOURCES RESEARCH CENTER.
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

HAWAIIAN SUGAR PLANTERS' ASSOCIATION, AIEA. CROP SCIENCE DEPT.
Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

IDAHO UNIV., MOSCOW. DEPT. OF AGRICULTURAL ENGINEERING.
Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

ILLINOIS STATE GEOLOGICAL SURVEY DIV., CHAMPAIGN.
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ENGINEERING.
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

IMS ENGINEERS, FAIRPORT, NY.
Reducing the Formation of Trihalomethanes,
W83-03997 5F

INDIAN COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.
Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

INDIAN GRASSLAND AND FODDER RESEARCH INST., JHANSI.
Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

INDIAN INST. OF TROPICAL METEOROLOGY, POONA.
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

INSTITUT FUER ENERGETIK, LEIPZIG (GERMAN D.R.).
Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

INSTITUT FUER WASSERWIRTSCHAFT, BERLIN (GERMAN D.R.).
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

INSTITUTE FOR SOIL FERTILITY, GRONINGEN (NETHERLANDS). DEPT. OF SOIL BIOLOGY.
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

INSTITUTE OF HYGIENE, GERA (GERMAN, D.R.).
Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

INSTITUTE OF HYGIENE, GERA (GERMAN, D.R.). DEPT. OF TOXICOLOGY.
A Threshold Concept of Environmental Pollutants,
W83-04057 5C

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT, WASHINGTON, DC.
Financial Aspects of Dam Safety,
W83-04078 8A

INTERNATIONAL ENGINEERING CO., INC., SAN FRANCISCO, CA.
Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

INTERNATIONAL RICE RESEARCH INST., LOS BANOS, LAGUNA (PHILIPPINES). DEPT. OF AGRONOMY.
Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

IONICS, INC., WATERTOWN, MA.
Solar Powered Electrodialysis - Part II,
W83-03921 3A

IOWA STATE UNIV., AMES.
Extraction of Priority Pollutants From Solids,
W83-03859 5D

IOWA STATE UNIV., AMES. DEPT. OF BOTANY.
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

IOWA STATE UNIV., AMES. DEPT. OF ECONOMICS.
Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

IOWA UNIV., IOWA CITY. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

ITHACA COLL., NY. DEPT. OF BIOLOGY.
Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

JOHANNESBURG CITY HEALTH DEPT. LABS. (SOUTH AFRICA).
Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

JOHN DEERE PRODUCT ENGINEERING CENTER, WATERLOO, IA.
Computer Aid for Terrace Location,
W83-03957 4D

JOHNSON (BERNARD), INC., HOUSTON, TX.
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

KANSAS AGRICULTURAL EXPERIMENT STATION, MANHATTAN. DEPT. OF AGRONOMY.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

KANSAS AGRICULTURAL EXPERIMENT STATION, MANHATTAN. EVAPOTRANSPIRATION LAB.
The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

KANSAS UNIV., LAWRENCE. DEPT. OF CIVIL ENGINEERING.
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

KANSAS WATER RESOURCES RESEARCH INST., MANHATTAN.
Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

KARLSRUHE UNIV. (GERMANY, F.R.). ENGLER-BUNTE INST.
Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

Use of Particle Size Analysis in Drinking Water Preparation (Zum Einsatz Von Partikelgrossenanalysen In Der Trinkwasseraufbereitung),
W83-04091 5A

KENTUCKY WATER RESOURCES RESEARCH INST., LEXINGTON.
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

KITAMI INST. OF TECH., HOKKAIDO (JAPAN).
Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, NY.
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

LAVALIN, INC., MONTREAL (QUEBEC).
P.I.D. Regulation Revisited,
W83-04080 6B

LINDE A.G., HOLLRIEGELSKREUTH (GERMANY, F.R.).
Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF CHEMISTRY.
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF CIVIL ENGINEERING.
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

LOUISIANA TECH UNIV., RUSTON. DEPT. OF AGRICULTURAL ENGINEERING.
Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

MANITOBA UNIV., WINNIPEG. DEPT. OF CIVIL ENGINEERING.
Discussion: Optimization of Water Resources for Irrigation in East Jordan, by Janusz R. Rydzewski and Hani A-H. Rashid,
W83-03936 3F

MARYLAND UNIV., COLLEGE PARK. DEPT. OF AGRONOMY.
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

MASSACHUSETTS UNIV., AMHERST. DEPT. OF BOTANY.
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

MASSACHUSETTS UNIV., AMHERST. DEPT. OF CIVIL ENGINEERING.
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

MASSACHUSETTS UNIV., AMHERST. DEPT. OF PLANT AND SOIL SCIENCES.
A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF CHEMICAL ENGINEERING.
Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

MEIDENSHA ELECTRIC MFG. CO. LTD., TOKYO (JAPAN). HYDRAULIC POWER GENERATION DIV.
Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CROP AND SOIL SCIENCES.
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

MINISTERE DE L'AGRICULTURE, PARIS (FRANCE).
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

MINISTRY OF CONSTRUCTION, TOKYO (JAPAN). RIVER BUREAU.
Experience in the Use of Rolled Concrete,
W83-04169 8F

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL AND MINING ENGINEERING.
Low Energy Filtration Using Buoyant Media,
W83-04149 5D

MINNESOTA UNIV., ST. PAUL. DEPT. OF HORTICULTURAL SCIENCE AND LANDSCAPE ARCHITECTURE.
Drought Hardening of Crop Plants,
W83-04150 2I

MISSOURI UNIV.-ROLLA.
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

MODENA UNIV. (ITALY). IST. DE IGIENE.
Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

MONTREAL UNIV. (QUEBEC). LAB. DE PHYSIQUE NUCLEAIRE.
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

MONTREAL URBAN COMMUNITY (QUEBEC).
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, GREENBELT, MD. LAB. FOR ATMOSPHERIC SCIENCES.
An Observational-Data Based Evapotranspiration Function for General Circulation Models,
W83-04116 2D

NATIONAL HYDROLOGY RESEARCH INST., OTTAWA (ONTARIO).
The Essence of Mathematical Models of Reservoir Storage,
W83-03852 4A

The Contamination and Protection of Aquifers,
W83-04020 5B

NATIONAL MUSEUM OF VICTORIA, MELBOURNE (AUSTRALIA).
Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

NEBRASKA UNIV. AT OMAHA. DEPT. OF CIVIL ENGINEERING.
Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

NEBRASKA UNIV., LINCOLN.
Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

NEBRASKA UNIV.-LINCOLN. CENTER FOR AGRICULTURAL METEOROLOGY AND CLIMATOLOGY.
Agricultural Meteorology in China,
W83-03851 2B

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRICULTURAL ENGINEERING.
Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRONOMY.
Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

NEBRASKA UNIV.-LINCOLN. INST. OF AGRICULTURE AND NATURAL RESOURCES.
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

NEBRASKA UNIV.-LINCOLN. SCHOOL OF LIFE SCIENCES.
Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

NEVADA UNIV. SYSTEM, RENO. BIORESOURCES CENTER.
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

NEVADA UNIV. SYSTEM, RENO. DESERT RESEARCH INST.
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

Nitrate in Nevada Playas,
W83-03994 5A

Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

NEW BRUNSWICK DEPT. OF THE ENVIRONMENT, FREDERICTON. WATER RESOURCES BRANCH.
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA).
Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

NEW YORK STATE COLL. OF AGRICULTURE AND LIFE SCIENCES, ITHACA. DIV. OF NUTRITIONAL SCIENCES.
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

NEWCASTLE UNIV. (AUSTRALIA). DEPT. OF CHEMISTRY.
The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

NORTH CAROLINA STATE UNIV. AT RALEIGH.
Sediment Pollution Control in North Carolina,
W83-03860 5G

The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

NORTH DAKOTA STATE UNIV., FARGO.
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF ZOOLOGY.
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

NORTH DAKOTA STATE UNIV., MANDAN. LAND RECLAMATION RESEARCH CENTER.
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

NORTH DAKOTA UNIV., GRAND FORKS. DEPT. OF CHEMISTRY.
Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

NORTH-EASTERN HILL UNIV., SHILLONG (INDIA). DEPT. OF BOTANY.
Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

O'BRIEN AND GERE ENGINEERS, INC., WHITE PLAINS, NY.
For.nation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

OAK RIDGE NATIONAL LAB., TN.
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

OHIO STATE UNIV., COLUMBUS. DEPT. OF ENTOMOLOGY.
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

OKAYAMA UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

ONTARIO MINISTRY OF AGRICULTURE AND FOOD, GUELPH. PESTICIDE RESIDUE LAB.
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

OREGON STATE DEPT. OF ENVIRONMENTAL QUALITY, PORTLAND.
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

OREGON STATE UNIV., CORVALLIS.
Economic Optimization of Irrigation,
W83-04007 3F

OREGON STATE UNIV., CORVALLIS. DEPT. OF ELECTRICAL AND COMPUTER ENGINEERING.
Discrete-Time, Cutback Furrow Irrigation,
W83-03958 3F

OREGON STATE UNIV., CORVALLIS. DEPT. OF FOREST ENGINEERING.
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

OREGON STATE UNIV., CORVALLIS. DEPT. OF MICROBIOLOGY.
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

OREGON STATE UNIV., CORVALLIS. DEPT. OF SOIL SCIENCE.
Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

ORISSA UNIV. OF AGRICULTURE AND TECHNOLOGY, BHUBANESWAR (INDIA). DEPT. OF PLANTS AND GENETICS.
Impact of Saline Water Irrigation on Some Crops and Their Varieties,
W83-03885 3C

OSAKA PREFECTURAL UNIV., SAKAI (JAPAN). LAB. OF ENVIRONMENTAL CHEMISTRY.
Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION, RIVERSIDE, CA.
Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF AGRICULTURAL ENGINEERING.
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

PENNSYLVANIA UNIV., PHILADELPHIA. DEPT. OF CIVIL AND URBAN ENGINEERING.
Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

PERKIN-ELMER CORP., NORWALK, CT.
The Determination of Trace Elements in Natural Waters Using the Stabilized Temperature Platform Furnace,
W83-04118 5A

PERUGIA UNIV. (ITALY). CATTEDRA DI IGIENE.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

PLM RESOURCE RECOVERY DIV., MALMO (SWEDEN).
Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

POITIERS UNIV. (FRANCE). LAB. DE CHIMIE DE L'EAU ET DES NUISANCES.
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

PRETORIA UNIV. (SOUTH AFRICA). DEPT. OF BIOCHEMISTRY.
Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

PUNJAB AGRICULTURAL UNIV., LUDHIANA (INDIA).
Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRONOMY.
The Mechanism of Raindrop Splash on Soil Surfaces,
W83-04034 2J

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

PURDUE UNIV., LAFAYETTE, IN. WATER RESOURCES RESEARCH CENTER.
Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

QUEBEC UNIV., RIMOUSKI. DEPT. OF OCEANOGRAPHY.
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

RHEINER MACHINENFABRIK WINDHOFF A.G. (GERMANY, F.R.).
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CHEMISTRY.
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

RIJKSINSTITUUT VOOR DE VOLKSGEZONDHEID, BILTHOVEN (NETHERLANDS). UNIT FOR RESIDUE ANALYSIS.
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

ROHM AND HAAS CO., SPRING HOUSE, PA.
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

ROME UNIV. (ITALY). IST. DE CHIMICA.
Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

S.K.N. COLL. OF AGRICULTURE, JOBNER (INDIA).
A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF SOIL SCIENCE.
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

SEVERN-TRENT WATER AUTHORITY (ENGLAND). LOWER TRENT DIV.
Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

SEVILLE UNIV. (SPAIN). DEPT. OF BASIC AND APPLIED CHEMISTRY.
Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

SHELL DEVELOPMENT CO., HOUSTON, TX.
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

SIMON FRASER UNIV., BURNABY (BRITISH COLUMBIA). DEPT. OF BIOLOGICAL SCIENCES.
Historic Changes in an Urban Watershed Determined by Pollen and Geochemical Analyses of Lake Sediment,
W83-04110 5C

SOCIETE D'ENERGIE DE LA BAIE JAMES, MONTREAL (QUEBEC).
Environmental Corrective Programs at the La Grande Complex (Les Amenagements Correctifs D'Environnement Au Complexe La Grande),
W83-04060 6G

SOUTH DAKOTA STATE UNIV., BROOKINGS. DEPT. OF CHEMISTRY.
Phosphate Extraction Using Fly Ash,
W83-03913 5F

SOUTH DAYTONA DEPT. OF BUILDING AND ENGINEERING, FL.
A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF FORESTRY.
Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

SOUTHERN WATER AUTHORITY, ST. LEONARDS (ENGLAND). EAST SUSSEX WATER AND DRAINAGE DIV.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

SRI INTERNATIONAL, MENLO PARK, CA. PHYSICAL ORGANIC CHEMISTRY DEPT.
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

STEWART, SVIRIDOV AND OLIVER, MARSHALLTOWN (SOUTH AFRICA).
Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

STICHTING VOOR BODEMKARTERING, WAGENINGEN (NETHERLANDS).
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

SVENSKA TRAEFORSKNINGSINSTITUTET, STOCKHOLM.
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

SYBRON CORP., BIRMINGHAM, NJ.
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

TASMANIA UNIV., HOBART (AUSTRALIA). DEPT. OF ZOOLOGY.
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

TECHNICAL UNIV. OF DENMARK, LYNGBY. DEPT. OF SANITARY ENGINEERING.
Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

TECHNISCHE UNIV., DRESDEN (GERMAN D.R.). BEREICH HYDROBIOLOGIE.
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W83-04047 5A

TECHNISCHE UNIV., MUNICH (GERMANY, F.R.). LEHRSTUHL FUER HYDROGEOLOGIE AND HYDROCHEMIE.
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

TENNESSEE UNIV., KNOXVILLE.
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

TEXAS AGRICULTURAL EXPERIMENT STATION, COLLEGE STATION.
Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

TEXAS CHRISTIAN UNIV., FORT WORTH. DEPT. OF GEOLOGY.
Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

TEXAS UNIV. AT AUSTIN. GEOTECHNICAL ENGINEERING CENTER.
Measurement of Hydraulic Conductivity of Unsaturated Soils with Thermocouple Psychrometers,
W83-04025 2G

TEXAS UNIV. AT EL PASO. DEPT. OF CHEMICAL ENGINEERING.
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

TEXAS WATER RESOURCES INST., COLLEGE STATION.
Water Conservation With Urban Landscape Plants,
W83-04140 3D

THAMES WATER AUTHORITY (ENGLAND). COTSWOLD DIV.
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

THESSALONIKI UNIV., SALONIKA (GREECE). ENVIRONMENTAL POLLUTION CONTROL LAB.
Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

Concentration of Heavy Metals in Seawater and Sediments from the Northern Aegean Sea, Greece,
W83-04056 5B

TORONTO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

TOYOHASHI UNIV. OF TECHNOLOGY (JAPAN). SCHOOL OF MATERIALS SCIENCE.
Determination of Deuterium Oxide in Water by Reversed-Phase High-Performance Liquid Chromatography,
W83-04190 5A

TRANSAMERICA DELAVAL, INC., SANTA MONICA, CA. BIPHASE ENERGY SYSTEMS.
Biphase Turbine for Reverse Osmosis Desalination,
W83-03910 8C

TRENT UNIV., PETERBOROUGH (ONTARIO).
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

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Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

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Evaluation of a Ground Transient Electromagnetic Remote Sensing Method for the Deep Detection and Monitoring of Salt Water Interfaces,
W83-03899 7B

UNIVERSITY OF SOUTHERN COLORADO, PUEBLO. DEPT. OF CHEMISTRY.
Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

UNIVERSITY OF THE WEST INDIES, ST. AUGUSTINE (TRINIDAD AND TOBAGO). DEPT. OF SOIL SCIENCE.
Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

UNIVERSITY OF WESTERN ONTARIO, LONDON. DEPT. OF PLANT SCIENCES.
Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

UOP, INC., ST. PAUL, MN. JOHNSON DIV.
Johnson Velocity Meter System Proves its Worth,
W83-04076 8B

UTAH AGRICULTURAL EXPERIMENT STATION, LOGAN.
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

UTAH STATE UNIV., LOGAN. COLL. OF NATURAL RESOURCES.
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

UTAH WATER RESEARCH LAB., LOGAN.
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

VERSAR, INC., SPRINGFIELD, VA.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

VICTORIA UNIV. (BRITISH COLUMBIA). DEPT. OF BIOCHEMISTRY AND MICROBIOLOGY.

Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CHEMICAL ENGINEERING.

Biological Regeneration of Activated Carbon,
W83-04133 5D

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CHEMISTRY.

Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CIVIL ENGINEERING.

Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

VIRGINIA STATE WATER CONTROL BOARD, RICHMOND. BUREAU OF WATER CONTROL MANAGEMENT.

Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.

Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

VSESOYUZNYI NAUCHNO-ISSLEDOVATEL'SKII INST. GIDROTEKHNIKI I MELIORATSII, MOSCOW (USSR).

Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

VYZKUMNY USTAV BALNEOLOGICKY, MARIENBAD (CZECHOSLOVAKIA).

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W83-04046 5F

VYZKUMNY USTAV VODOHOSPODARSKY, OSTRAVA (CZECHOSLOVAKIA).

Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

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Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

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W83-04050 5A

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).

Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

Effective Use of STOM,
W83-03931 5D

Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

WATER RESEARCH COMMISSION, PRETORIA (SOUTH AFRICA).

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W83-03969 3C

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Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

WAYNE STATE UNIV., DETROIT, MI.

Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

WESLEYAN UNIV., MIDDLETOWN, CT.

Analysis of Chemistry Associated With Ozonolysis of Organic Pollutant Molecules in Water,
W83-04141 5A

WEST VIRGINIA UNIV., MORGANTOWN. WATER RESEARCH INST.

Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

WILLIAM AND MARY COLL., GLOUCESTER POINT, VA. INST. OF MARINE SCIENCE.

Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03873 5C

WINDSOR UNIV. (ONTARIO). ENVIRONMENTAL MICROBIOLOGY RESEARCH LAB.

Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

WISCONSIN UNIV.-MADISON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.

Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

WISCONSIN UNIV.-MADISON. LAB. OF LIMNOLOGY.

Low pH and the Absence of Fish Species in Naturally Acidic Wisconsin Lakes: Inferences for Cultural Acidification,
W83-04108 5C

WISCONSIN UNIV.-MADISON. WATER RESOURCES CENTER.

Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.

Characteristics of Sediment and Organic Carbon Export From Pristine Boreal Forest Watersheds,
W83-04109 2E

ZARAGOZA UNIV. (SPAIN). DEPT. OF ANALYTICAL CHEMISTRY.

Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

ACCESSION NUMBER INDEX

W83-03851 2B
W83-03852 4A
W83-03853 2E
W83-03854 5C
W83-03855 2H
W83-03856 5B
W83-03857 6E
W83-03858 5E
W83-03859 5D
W83-03860 5G
W83-03861 5E
W83-03862 5G
W83-03863 4B
W83-03864 8B
W83-03865 8B
W83-03866 3C
W83-03867 3F
W83-03868 3F
W83-03869 3F
W83-03870 5C
W83-03871 3F
W83-03872 2B
W83-03873 3F
W83-03874 5C
W83-03875 3F
W83-03876 5C
W83-03877 5C
W83-03878 5C
W83-03879 5D
W83-03880 2L
W83-03881 2A
W83-03882 2A
W83-03883 2G
W83-03884 2B
W83-03885 3C
W83-03886 4A
W83-03887 3F
W83-03888 3C
W83-03889 3C
W83-03890 2H
W83-03891 2H
W83-03892 5C
W83-03893 5B
W83-03894 4C
W83-03895 5B
W83-03896 5B
W83-03897 5B
W83-03898 5B
W83-03899 7B
W83-03900 5B
W83-03901 5F
W83-03902 6E
W83-03903 7A
W83-03904 3F
W83-03905 5E
W83-03906 7C
W83-03907 3B
W83-03908 5G
W83-03909 5B
W83-03910 8C
W83-03911 5B
W83-03912 8C
W83-03913 5F
W83-03914 8B
W83-03915 6G
W83-03916 5F
W83-03917 3F
W83-03918 7C
W83-03919 5G
W83-03920 2F
W83-03921 3A
W83-03922 6D
W83-03923 5C
W83-03924 5B
W83-03925 5D
W83-03926 5D
W83-03927 5D
W83-03928 5D
W83-03929 5D
W83-03930 5D
W83-03931 5D
W83-03932 5C
W83-03933 5A
W83-03934 5A
W83-03935 5B
W83-03936 3F
W83-03937 5B
W83-03938 5A
W83-03939 8G
W83-03940 2F
W83-03941 5D
W83-03942 8C
W83-03943 6E
W83-03944 5D
W83-03945 5E
W83-03946 5D
W83-03947 5D
W83-03948 2G
W83-03949 4A
W83-03950 6E
W83-03951 5D
W83-03952 5D
W83-03953 5D
W83-03954 5D
W83-03955 5D
W83-03956 3F
W83-03957 4D
W83-03958 3F
W83-03959 3F
W83-03960 4D
W83-03961 2A
W83-03962 2A
W83-03963 2J
W83-03964 5F
W83-03965 3C
W83-03966 2J
W83-03967 5B
W83-03968 2L
W83-03969 3C
W83-03970 5E
W83-03971 3C
W83-03972 2G
W83-03973 2J
W83-03974 2B
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W83-03976 5B
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W83-03982 5B
W83-03983 5B
W83-03984 5B
W83-03985 3C
W83-03986 5B
W83-03987 5B
W83-03988 5B
W83-03989 2K
W83-03990 4C
W83-03991 5F
W83-03992 2B
W83-03993 7C
W83-03994 5A
W83-03995 5G
W83-03996 2E
W83-03997 5F
W83-03998 4B
W83-03999 5A
W83-04000 2K
W83-04001 6B
W83-04002 5D
W83-04003 5A
W83-04004 5B
W83-04005 2L
W83-04006 5B
W83-04007 3F
W83-04008 2J
W83-04009 2A
W83-04010 2A
W83-04011 3B
W83-04012 7C
W83-04013 2E
W83-04014 7C
W83-04015 10C
W83-04016 5A
W83-04017 6G
W83-04018 5D
W83-04019 2B
W83-04020 5B
W83-04021 2C
W83-04022 5C
W83-04023 5F
W83-04024 6B
W83-04025 2G
W83-04026 2G
W83-04027 2G
W83-04028 4D
W83-04029 2G
W83-04030 2F
W83-04031 2G
W83-04032 3F
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W83-04034 2J
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W83-04036 2G
W83-04037 2J
W83-04038 3B
W83-04039 3F
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W83-04041 2G
W83-04042 2G
W83-04043 2G
W83-04044 2G
W83-04045 2H
W83-04046 5F
W83-04047 5A
W83-04048 5D
W83-04049 5C
W83-04050 5A
W83-04051 5B
W83-04052 5F
W83-04053 5A
W83-04054 5C
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W83-04057 5C
W83-04058 5F
W83-04059 2H
W83-04060 6G
W83-04061 3C
W83-04062 2G
W83-04063 2G
W83-04064 5C
W83-04065 6F
W83-04066 3F
W83-04067 2J
W83-04068 5E
W83-04069 5E
W83-04070 7B
W83-04071 2G
W83-04072 3F
W83-04073 5D
W83-04074 5D
W83-04075 5D
W83-04076 8B
W83-04077 8G
W83-04078 8A
W83-04079 8C
W83-04080 6B
W83-04081 8D
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W83-04083 8F
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W83-04085 5D
W83-04086 5D
W83-04087 3F
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W83-04089 3F
W83-04090 5G
W83-04091 5A
W83-04092 2F
W83-04093 5B
W83-04094 5A
W83-04095 5B
W83-04096 2K
W83-04097 5B
W83-04098 5B
W83-04099 5D
W83-04100 5E
W83-04101 5E
W83-04102 3F
W83-04103 2H
W83-04104 5C
W83-04105 5B
W83-04106 5C
W83-04107 2H
W83-04108 5C
W83-04109 2E
W83-04110 5C
W83-04111 3F
W83-04112 3C
W83-04113 3F
W83-04114 5D
W83-04115 5D
W83-04116 2D
W83-04117 2L
W83-04118 5A
W83-04119 5A
W83-04120 3F
W83-04121 3B
W83-04122 5A
W83-04123 5A
W83-04124 5A
W83-04125 5A
W83-04126 5A
W83-04127 5A
W83-04128 5A
W83-04129 5A
W83-04130 8G
W83-04131 5B
W83-04132 5D
W83-04133 5D
W83-04134 5D
W83-04135 4A
W83-04136 3F
W83-04137 2A
W83-04138 2E
W83-04139 5C
W83-04140 3D
W83-04141 5A
W83-04142 5C
W83-04143 3A
W83-04144 5B
W83-04145 2A
W83-04146 5C
W83-04147 3A
W83-04148 5B
W83-04149 5D
W83-04150 2I
W83-04151 5C
W83-04152 6F
W83-04153 6E
W83-04154 3C
W83-04155 6G
W83-04156 6B
W83-04157 2F
W83-04158 7C
W83-04159 5B
W83-04160 3F
W83-04161 5D
W83-04162 3A
W83-04163 2A
W83-04164 3E
W83-04165 5C
W83-04166 8C
W83-04167 8C
W83-04168 8C
W83-04169 8F
W83-04170 6C
W83-04171 5B
W83-04172 5D
W83-04173 5B
W83-04174 5C
W83-04175 5F
W83-04176 5A
W83-04177 5D
W83-04178 5D
W83-04179 5D
W83-04180 5E
W83-04181 5D
W83-04182 5D
W83-04183 5D
W83-04184 5D
W83-04185 2J
W83-04186 5B

W83-04187

W83-04187 5D
W83-04188 5F
W83-04189 5A
W83-04190 5A
W83-04191 5A
W83-04192 5A
W83-04193 2F
W83-04194 5A
W83-04195 5A
W83-04196 3A
W83-04197 4D
W83-04198 5D
W83-04199 5B
W83-04200 5E

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

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